FEBRUARY • 1950

WIRE AND WIRE PRODUCTS

CRO MACHINE COMPANY • PERTH AMBOY • NEW JERSEY • USA

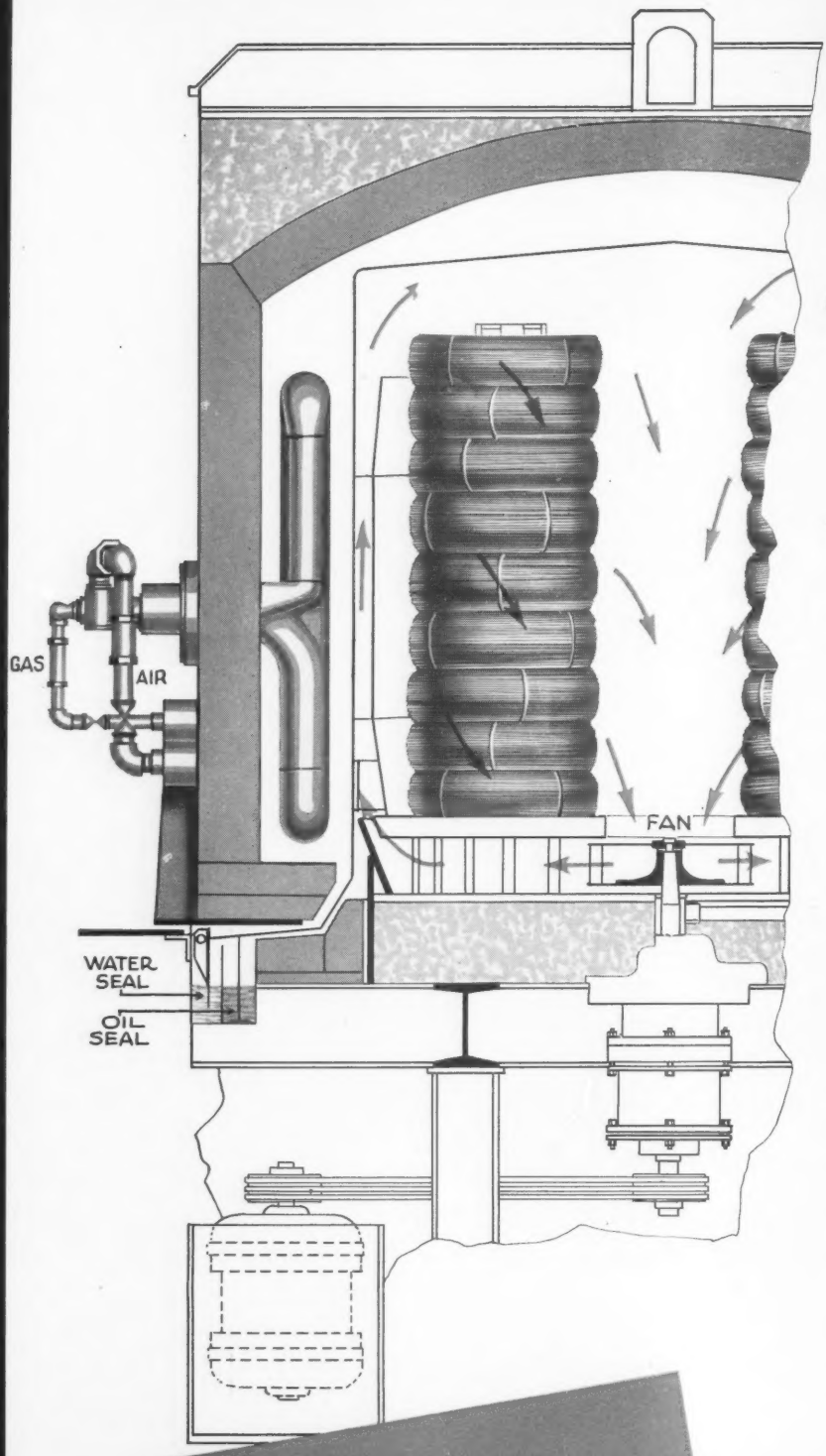
PUBLISHED BY THE WIRE ASSOCIATION

Lee Wilson announces the New

RADIANT CONVECTOR FURNACE

for

Wire Annealing



THIS NEW WIRE ANNEALING furnace utilizes the high speed convection heating system developed for and widely used in Wilson furnaces for strip coil annealing.

A high static, high volume fan, driven by a motor rated from 10 to 20 HP, drives the gases through an annulus between the inner cover and inner cover liner at velocities which produce heat transfers resulting in faster heating, faster cooling and better physical properties in the material being annealed.

To provide the greater amount of heat input required for this faster processing, these furnaces are equipped with "O" type radiant firing tubes. Fuel economies of at least 15% result from the use of this new type of firing tube.

PATENT No. 2,485,995

Lee Wilson

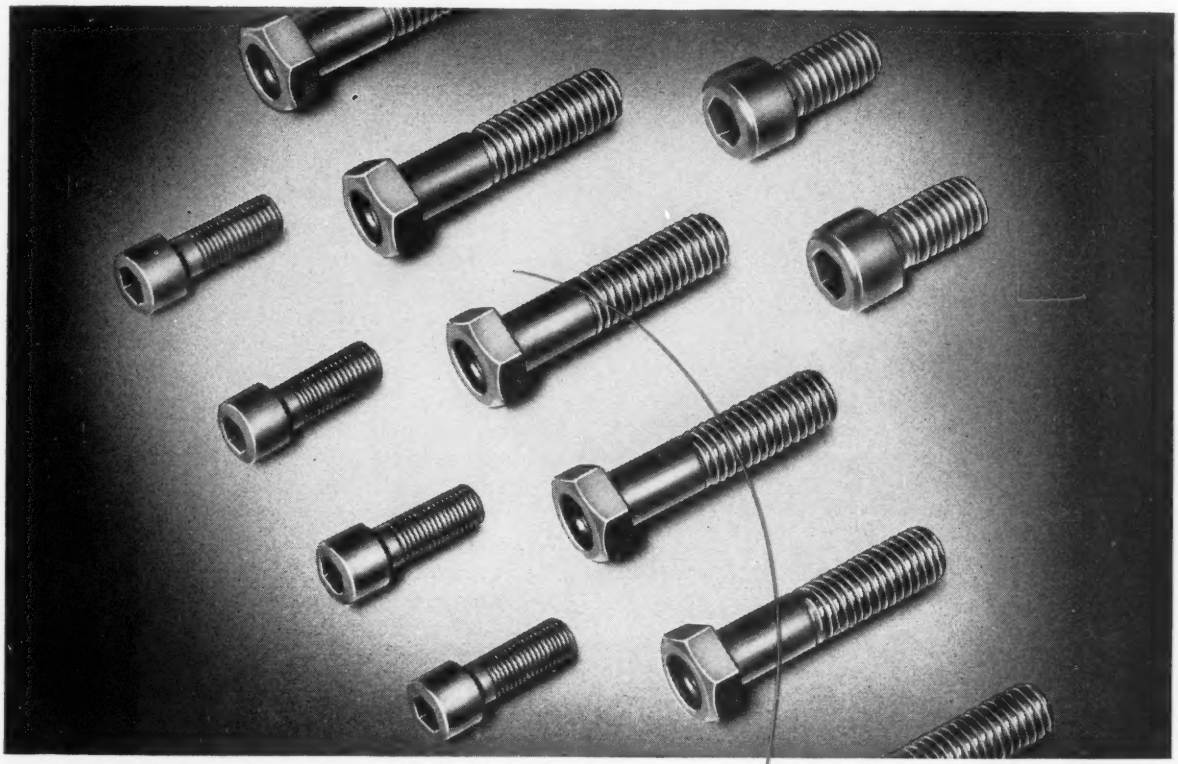
ENGINEERING *Co., Inc.*

20005 WEST LAKE ROAD • CLEVELAND, OHIO

Telephone ACademy 4670

INDUSTRIAL FURNACES ★ RADIANT TUBE HEATING ★ HEAT TREATING PROCESSES

Quality control provides GREATER UNIFORMITY in U·S·S Amerloy Wire



IN *every* step in the production of U·S·S Amerloy, a high quality alloy heading wire, quality is carefully controlled. This careful control means that every inch of Amerloy is remarkably free from physical defects, thus keeping production rates high and tooling problems low.

Too, quality control means that Amerloy has a uniform surface texture. Uniform color. Accurate dimensions. And it means that we can meet your requirements for strength, hardness, stiffness and workability.

We'd like to show you how Amerloy can help you. So why not contact us? We can ship this heading wire to you NOW, in the quantities you need.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

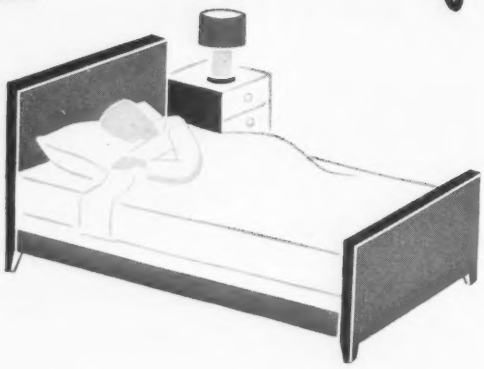
If you use Alloy Wire... use **Amerloy**

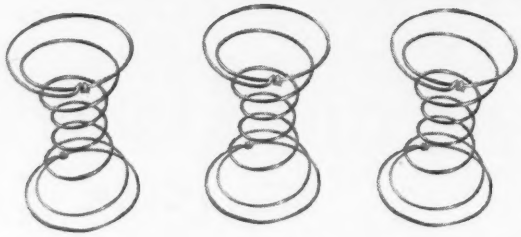
USS

UNITED STATES STEEL

SILVER STAR SPRINGS
for cushioned comfort

HOME





Steel springs provide deep-cushioned comfort in automobile seats, chairs, innerspring mattresses, and other places where buoyant, restful support is essential.

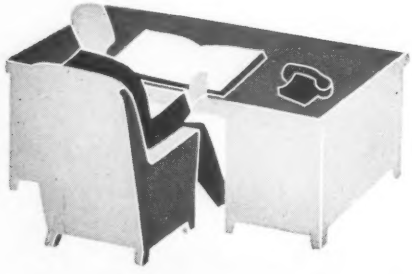
The wire in good upholstery springs must be a special kind of steel, one engineered for this application alone. That is why Silver Star Spring Wire is so extensively used. Leading spring and bedding manufacturers use Silver Star because it fully meets the requirements for upholstery springs.

TRAVEL

Silver Star is a special-analysis, high-carbon wire that's carefully processed to assure easy coiling and knotting. Springs made from it have uniform height and resiliency, keep their liveliness and retain their shape through a lifetime of lasting comfort. You can count on its uniformity . . . in gage, temper, physical properties.

Silver Star is but one of Bethlehem's wire specialties. If you have a problem in the selection or processing of steel wire, it may save you time and money to ask for a Bethlehem engineer to study your requirements.

OFFICE



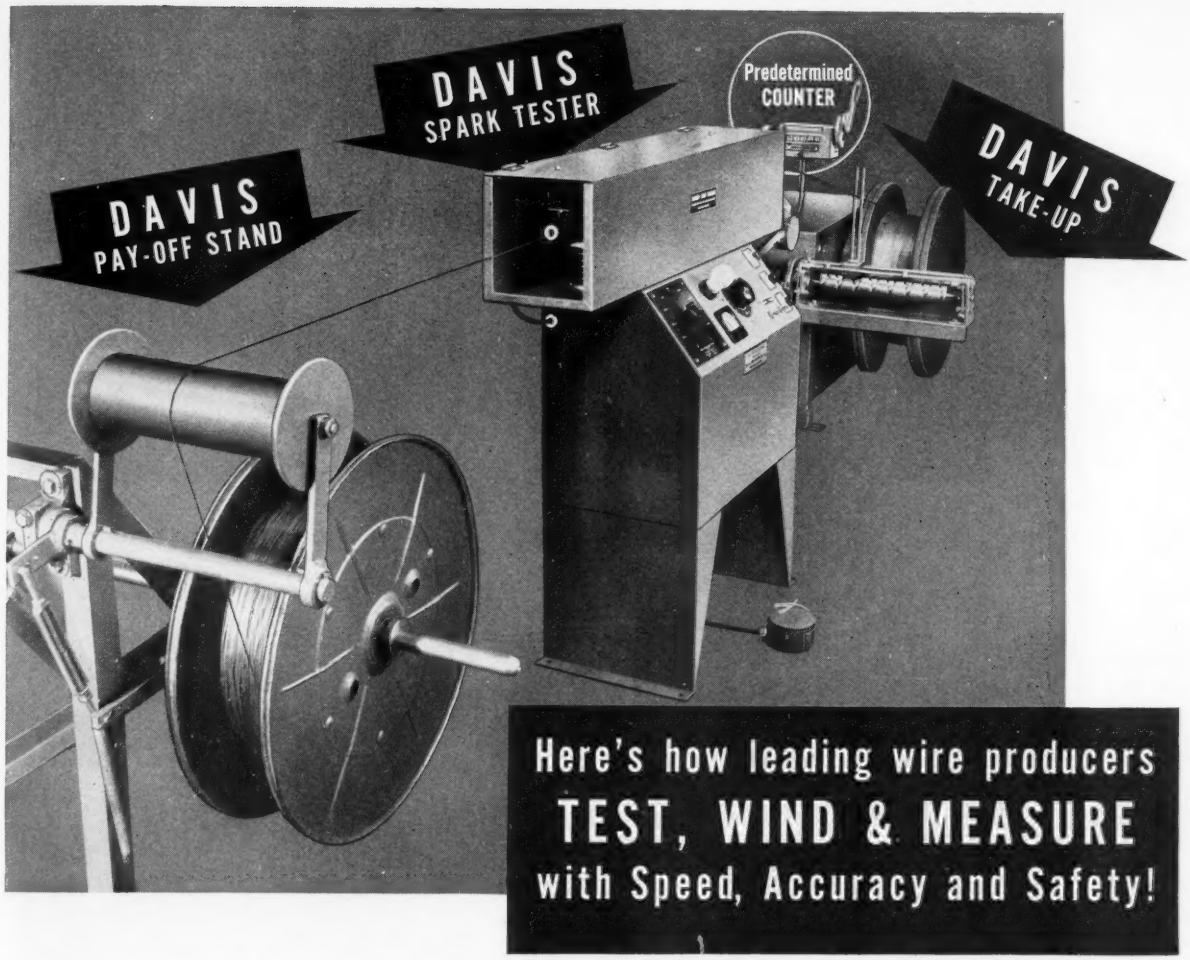
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Silver Star SPRING WIRE
BETHLEHEM STEEL COMPANY

WIRE & WIRE PRODUCTS, Vol. 25, No. 2, February, 1950. Publication Office, at One Sherman Ave., Jersey City 7, N. J. Executive Office, 300 Main Street, Stamford, Conn. Published monthly by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secy. and Treas. Subscription price: U. S. $5.00; Canada, $5.00 per year; 50 cents per copy; Foreign, $7.50 per year. Entered as second class matter, January 10, 1949, at the Post Office, Jersey City, N. J., under Act of March 3, 1879.



Simple, All-Automatic Operation!

PAY-OFF FEATURES

- Controls tension and braking automatically!
- Prevents over-travel of wire and wire breakage!
- Stops instantaneously when winding spool stops!
- Self-aligning ball bearing pillow block reduces friction!

PRICES
Pay-off stand $125
Spark Tester $400

SPARK TESTER FEATURES

- Detects all dielectric faults!
- Tests wire at any desired voltage!
- Push-button Start & Stop Control!
- Electrically measures predetermined lengths, and stops when pre-set run is completed!
- Automatic torque control for slow starting prevents breaking or stretching of wires!
- Meets Underwriters Laboratories' specifications for spark testing!

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- Worthington All-Speed Drive feeds at 100 to 1500 feet per minute. Other speed ranges available.
- Equipped with automatic brake!
- Stops instantaneously when fault occurs!
- Motor-driven adjustable traverse with width-adjusting stops!

PRICE
Take-up $700

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You Can Cut Costs on Your Spring Grinding Jobs.. with NORTON Discs!

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PLUS — Lower Initial Cost —vitrified discs cost substantially less than resinoid discs.

Try vitrified discs of the latest Norton abrasive development—32 ALUNDUM abrasive—for best results on critical stainless steel grinding jobs (suggested specification, 32A36-J12VBEP). And for cutting costs on your alloy steel jobs, try discs of tough, sharp 57 ALUNDUM abrasive (suggested specification, 57A246-L11VBEP). They're available in all standard sizes (15" to 72" in diameter) and with all types of mountings.

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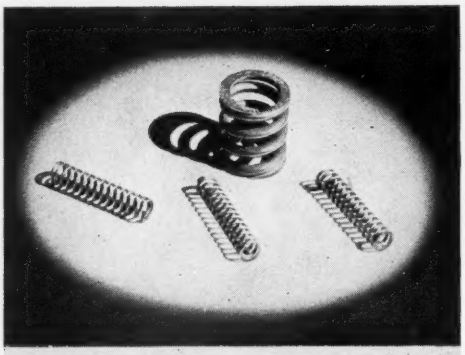
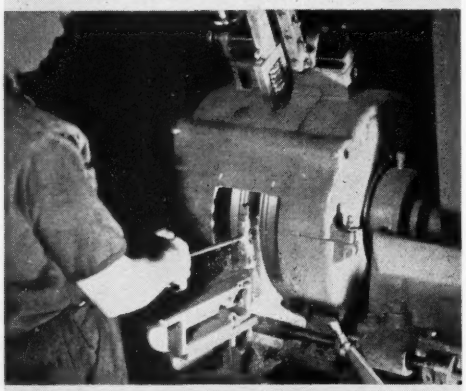
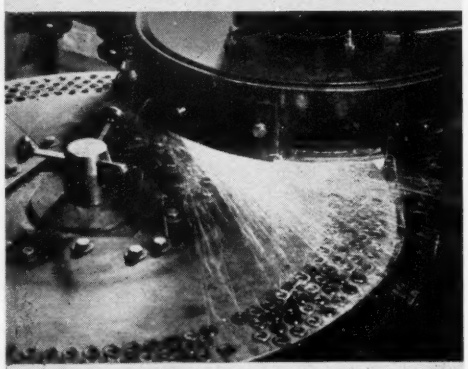


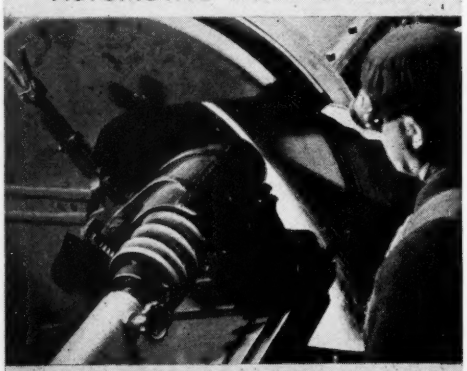
STAINLESS STEEL SPRINGS



SMALL WIRE SPRINGS

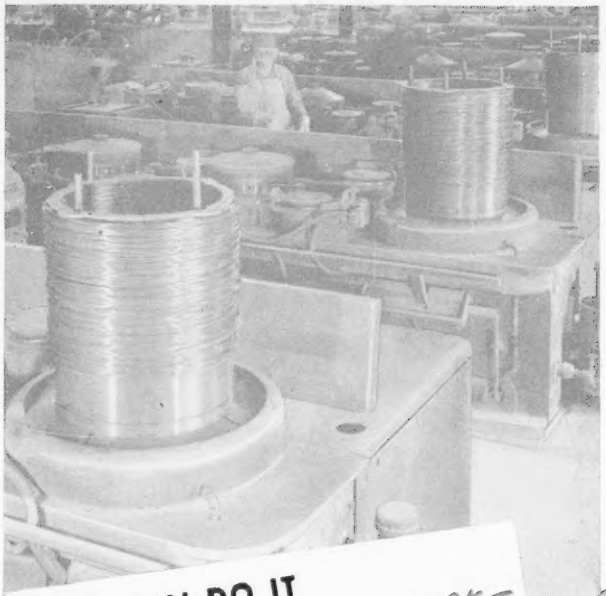


AUTOMOTIVE VALVE SPRINGS



HEAVY WIRE SPRINGS

"Making better products to make other products better"



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better, faster, cheaper—
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S-183

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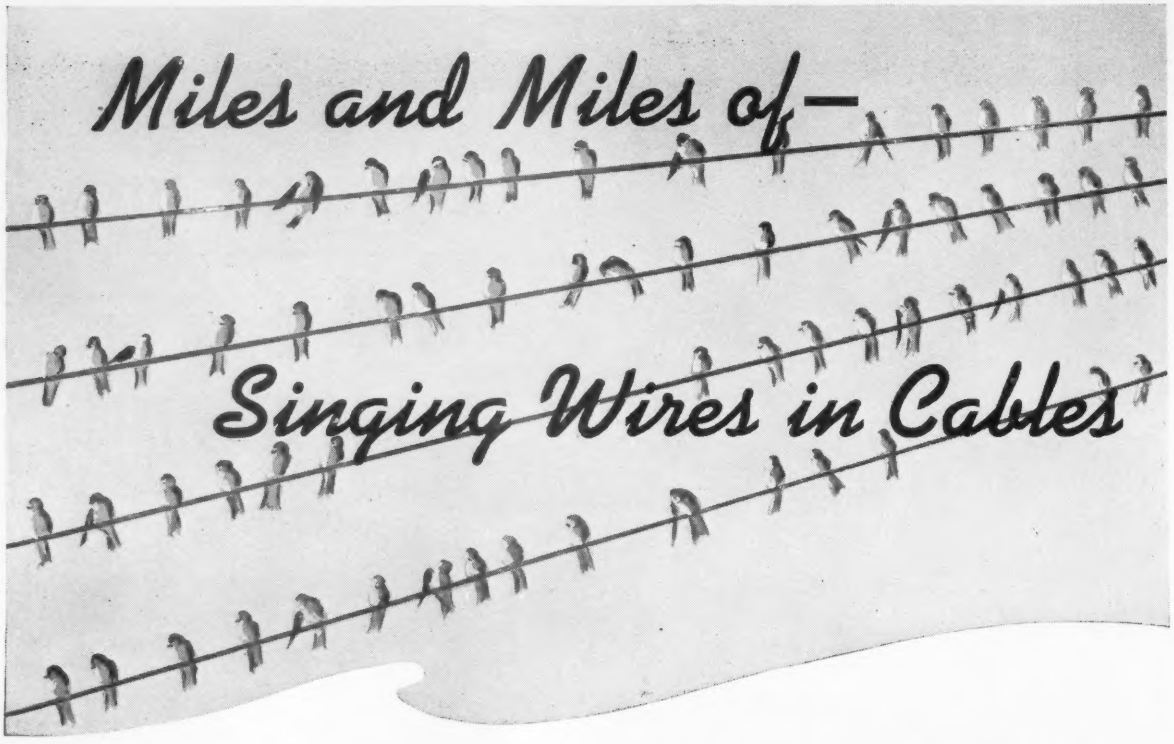

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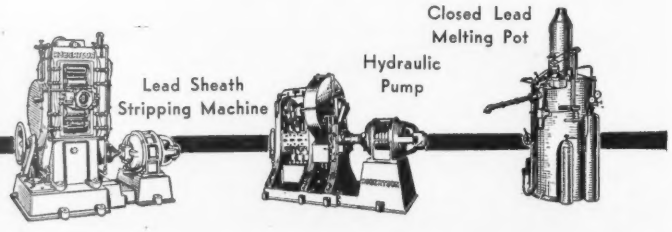

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...it *keeps* your wire goods sold

Look what a milk bottle carrier does. It knocks around in a truck all day. Carries wet bottles. Stands repeated steaming. Yet it stays on the job year after year when made of Alcoa Aluminum Wire. Because aluminum *lasts*.

Make *your* products of Alcoa Wire and you offer the same highly salable advantage of long life.

Your shopmen will like the way Alcoa Wire forms on your present equipment. Simple procedures make painted and plated finishes cling to it. Or you can eliminate finishing altogether. Your local Alcoa salesman will tell you more about this economical wire that goes three times further than heavy metals. Ask him to furnish you with free books like "Alcoa Aluminum and Its Alloys" plus "Finishes for Alcoa Aluminum". Or write ALUMINUM COMPANY OF AMERICA, 1950B Gulf Building, Pittsburgh 19, Pennsylvania.

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Improved shop practice reduces costs, helps meet competition. And you'll reduce costs with money-saving, time-saving Talide Dies that outwear steel dies at least 20 times, and on many occasions outwear them as high as 50 to 1. Too, down time of your equipment can be reduced by over 50% since Talide Metal needs little redressing. Made from hardest metal known, with great compressive strength, wear on Talide drawing dies after thousands of draws is almost negligible! Send for Die and Wear Part Catalog 48-WP.

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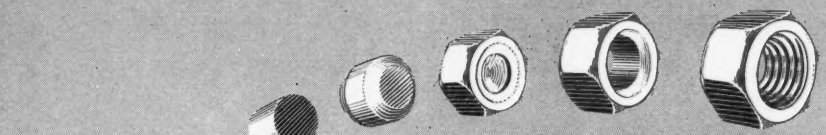
CUTTING TOOLS · DRAWING DIES · WEAR RESISTANT PARTS

Scrapless Nut Wire

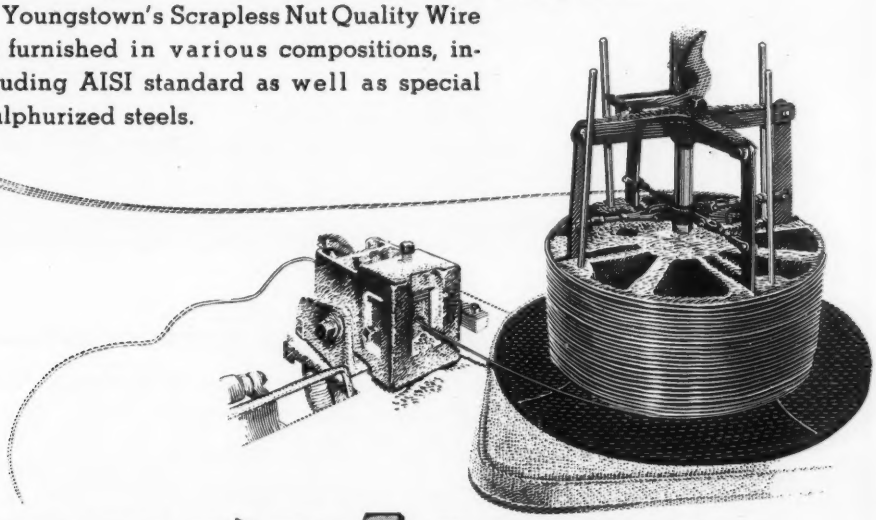
custom built to meet customers' requirements



SCRAPLESS Nut Quality Wire is not an ordinary steel for common applications. It is a custom built product designed to meet customers' specific requirements for cold heading, cold punching, cold expanding and threading, in the production of a variety of nut shapes on continuous heading machines.

Every step of its manufacture is carefully controlled--from the melting furnaces to the final drawing operation on the wire machines. Each coil of wire is subjected to close inspection and rigid tests with modern electrical testing apparatus.

Youngstown's Scrapless Nut Quality Wire is furnished in various compositions, including AISI standard as well as special sulphurized steels.



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Youngstown STEEL WIRE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

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2. Descaling at 700°F. may be applied to all ferrous and austenitic steels and most non-ferrous metals.
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4. The residual heat can be used to clean directly after any normalizing or annealing cycle.
5. By balancing out the use of Sodium descaling to brightening acids—there can be no stream pollution problem.

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1. Contracts are available for—Sodium—Caustic—and Ammonia. Delivery guaranteed.

Equipment:

1. Packaged units for any production operation.
2. Continuous units that can be used as part of existing processing equipment.

Proven:

1. Installations can be inspected in production operation.
2. Samples: Free sample will be cleaned to demonstrate manufacturing savings.

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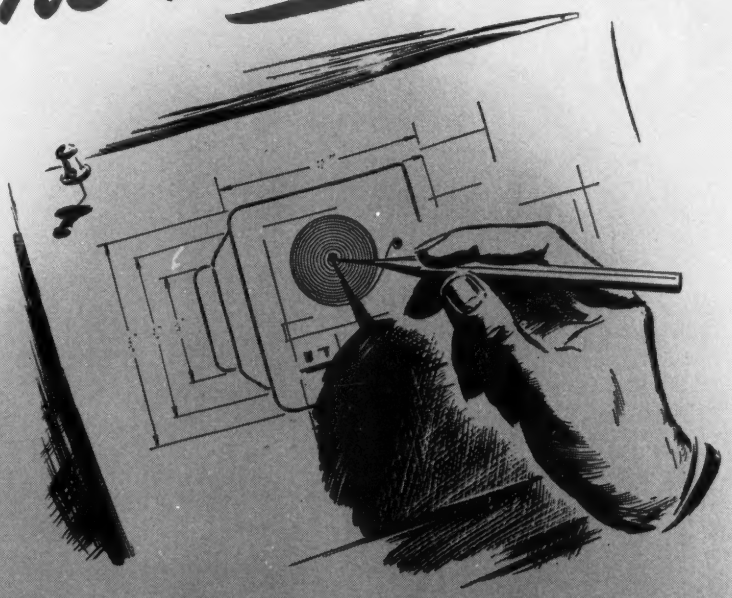

Why production men choose Roebling Cold Rolled Spring Steel

IT'S BEEN PROVED in plants the country over . . . that Roebling Cold Rolled Spring Steel saves preparation time on machines, minimizes machine stoppages, and cuts down the number of rejects. And this is only natural! Every inch of Roebling Spring Steel is identical in gauge, grain and finish . . . meets users' specifications with absolute uniformity.

Roebling Cold Rolled Spring Steel is available annealed, hard rolled untempered; scaleless tempered; tempered and polished; tempered, polished and strawed; or tempered, polished and blued.

Your Roebling Field Man will gladly help you choose the cold rolled spring steel, or round, flat or shaped wire, that will improve your product and your production. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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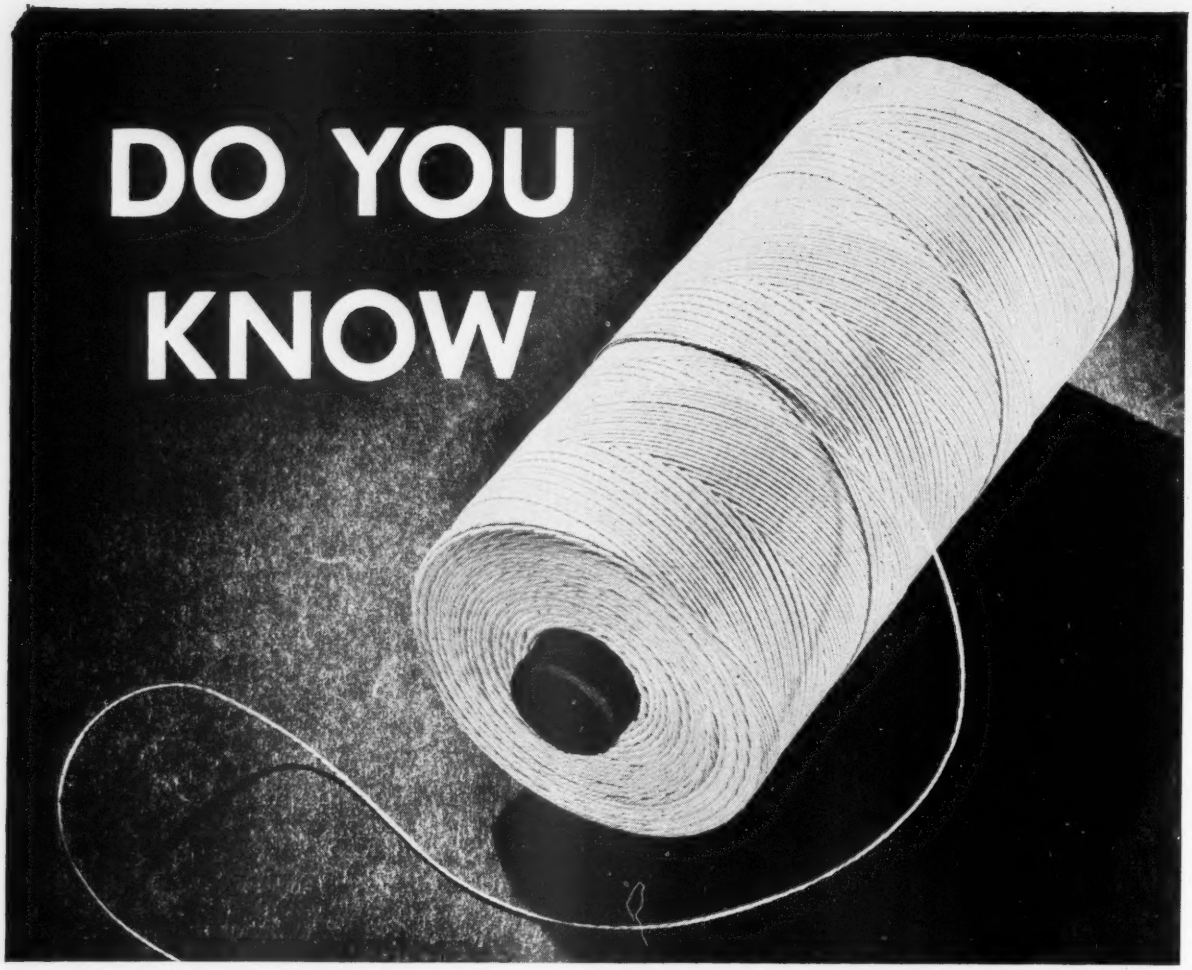

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- HIGH TENSILE STRENGTH
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- SMALL SIZE—PERMITS THICKER JACKET WALL —IMPROVES APPEARANCE
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*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

Monel pickling hook used at the Pittsburgh Steel Co., Pittsburgh, Pa.

Fabricated by Youngstown Welding and Engineering Co., Youngstown, Ohio.

6 times longer life since switching to "Monel" Pickling Hooks!

Longer life is an old story to users of Monel* pickling equipment, **(over 40 years old in fact.)**

Pittsburgh Steel Company, too, found that out when they installed Monel pickling hooks to handle coils of steel wire.

Before turning to Monel, hooks of other materials had been tried. *Sulfuric acid and wire-coating chemicals ruined all of them within seven months!*

The Monel hooks, however, ended that problem. So far, they have outlasted the best of the others by six times, and are still in service after 3½ years.

Today, at Pittsburgh Steel, 14 Monel hooks are in operation, each handling payloads up to 2400 pounds.

"PICK" MONEL *for all types of pickling equipment. It can be fabricated to your needs out of economical, standard mill forms. For more information on Monel and Monel fabricators, write our Ray Reddell.*

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DESIGNERS and MANUFACTURERS! Sand castings and precision castings of Monel, Nickel, Inconel and other Nickel alloys are available from INCO's own foundry.

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"MONEL*" Pickling Equipment means *Extra* CAPACITY . . . *Extra* LIFE . . . *Extra* SAFETY

DEAD SOFT . . . AND EASY ON YOUR WIRE WORKING MACHINES

WISSCO SPHEROIDIZED WIRE

Steel with this grain structure resists forming and is tough on wire working tools and dies.

Spheroidizing changes the free cementite in steel from elongated shapes to small nodules or spheroids thus rendering the steel soft and ductile.

Here's a wire that is really friendly to forming dies and wire working machines. It's dead soft . . . takes severe bends beautifully . . . is easy to cut, swage, grind and polish. After forming, its temper or hardness can be restored.

Because of these characteristics, Wissco Spheroidized Wire is ideally suited for making screw drivers, awls, ice-picks, parts of toys and other products the manufacture of which calls for severe wire forming.

The secret of the superiority of Wissco Spheroidized Wire lies in the use of specially selected heats of steel and exacting control of the heat treating operation to insure complete and uniform heating of each batch of wire.

If you want further information on Wissco Spheroidized, or any of Wickwire Spencer's innumerable types of high or low carbon steel specialty wires, won't you write us? Our metallurgists have a reputation for finding the answers to unusual wire applications.

WISSCO *Wire*

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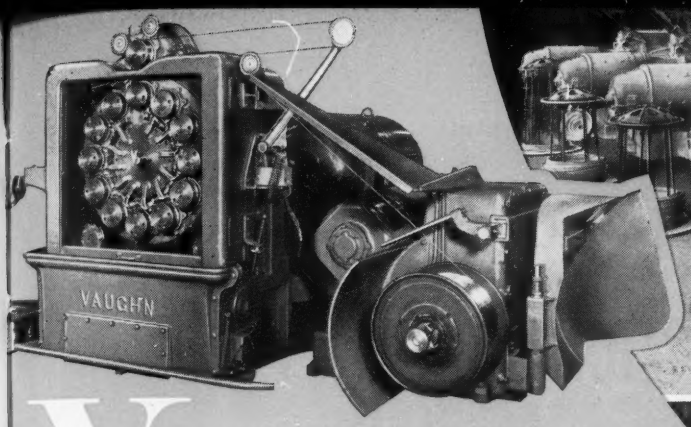
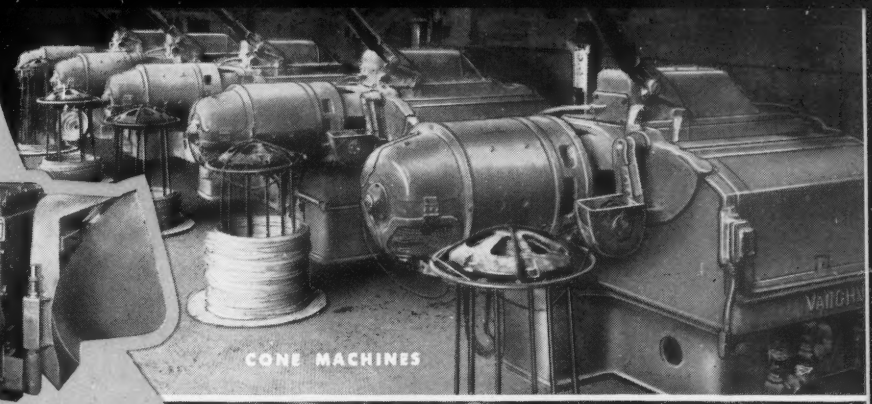
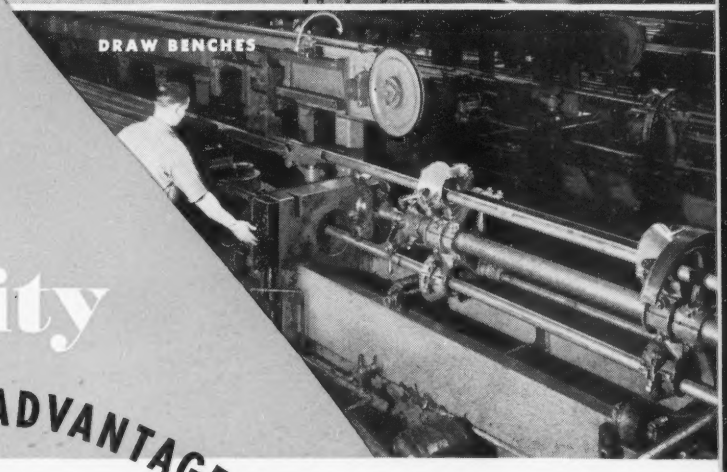


RINGBLOX



CONE MACHINES



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Very Valuable Versatility

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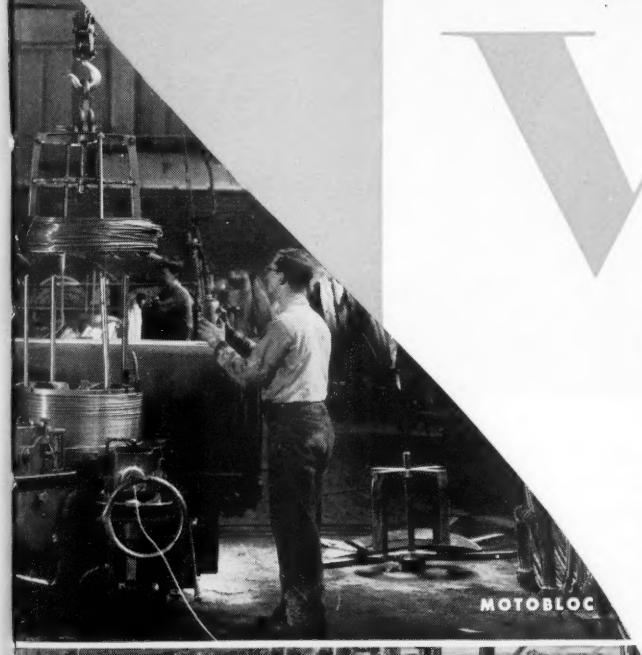

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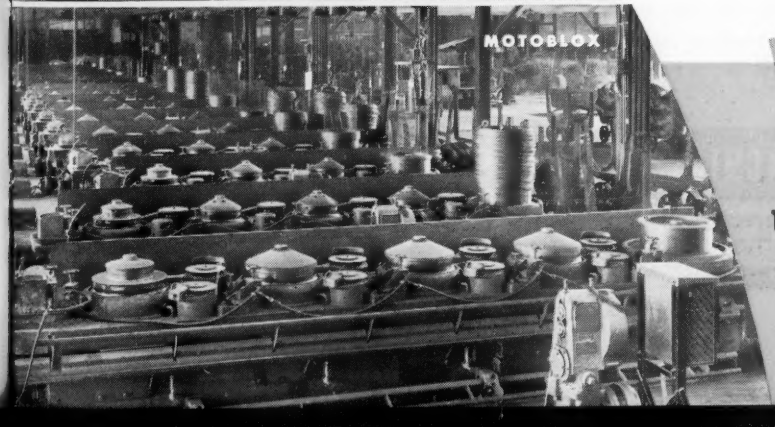

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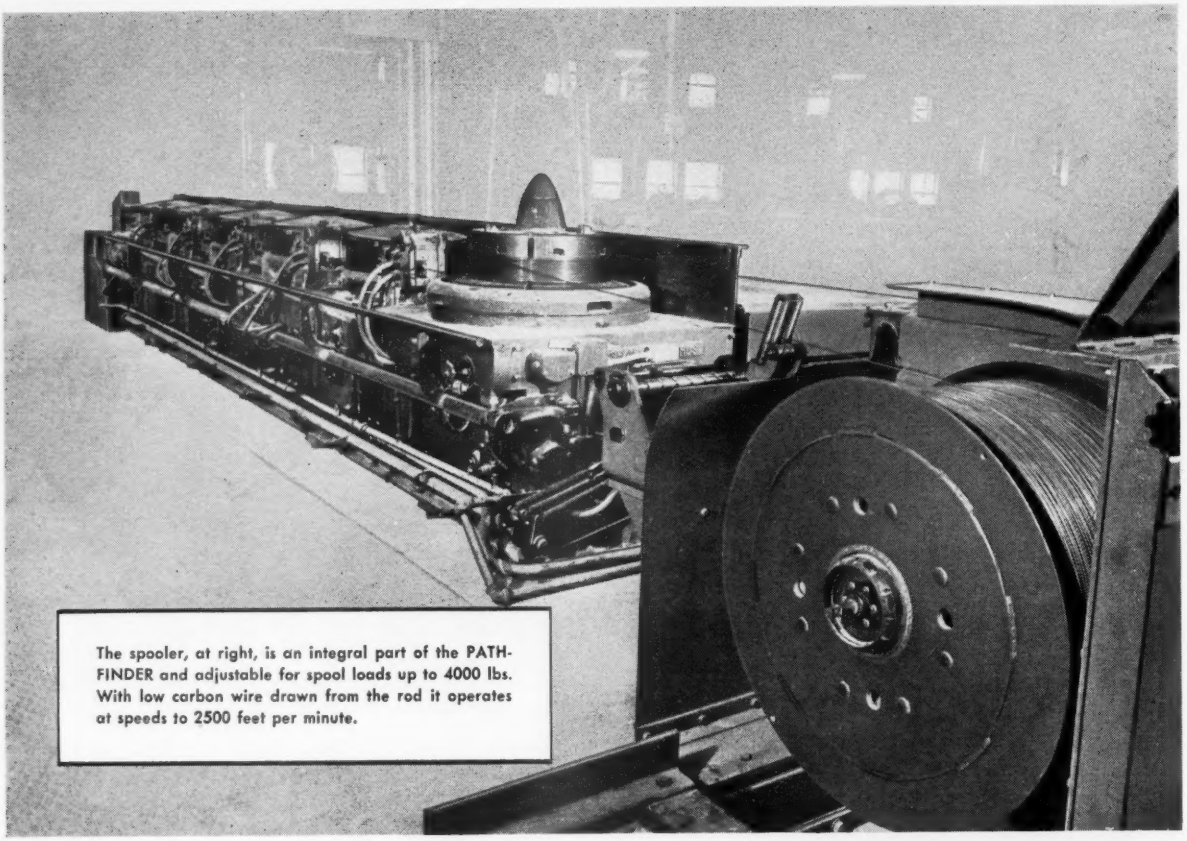

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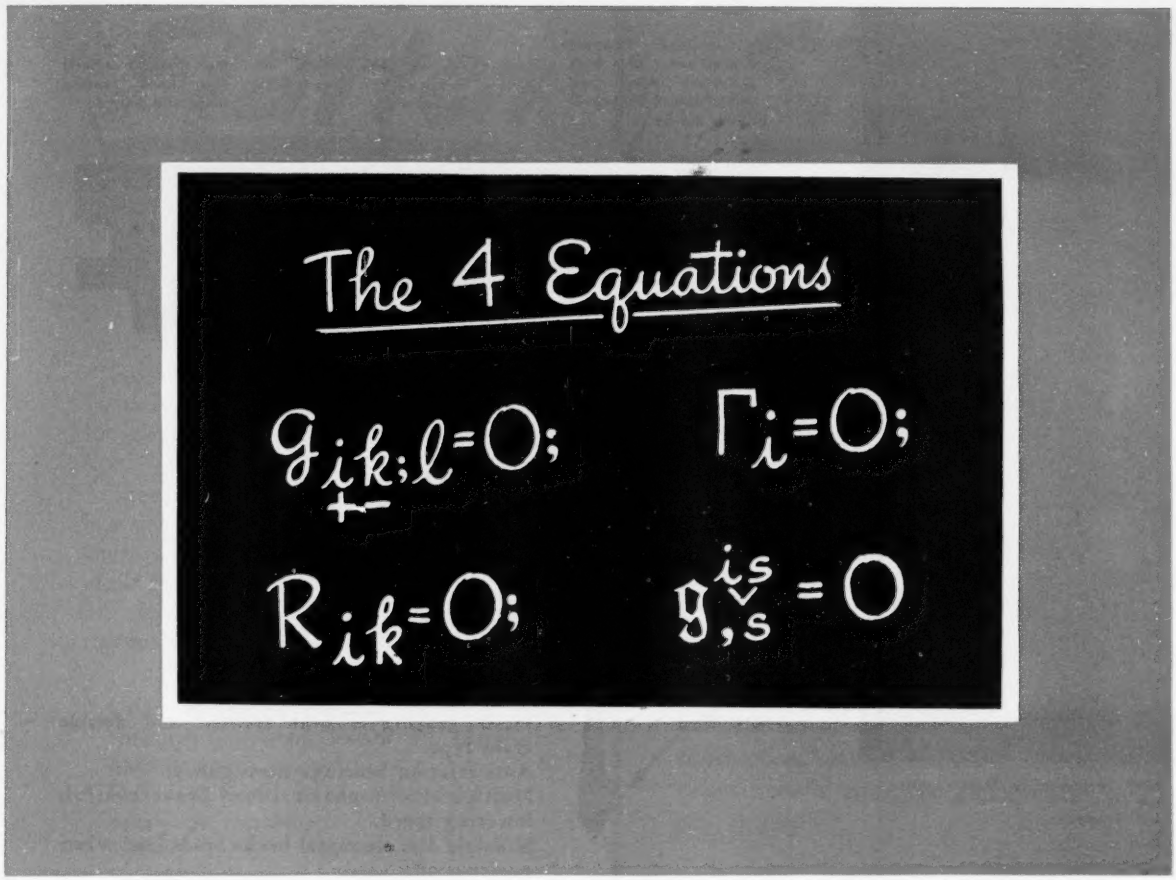

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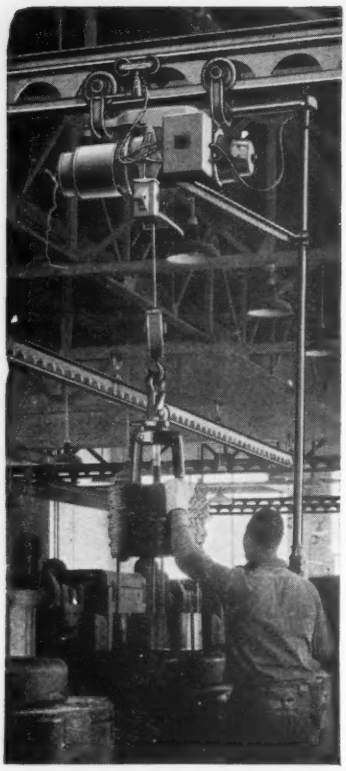

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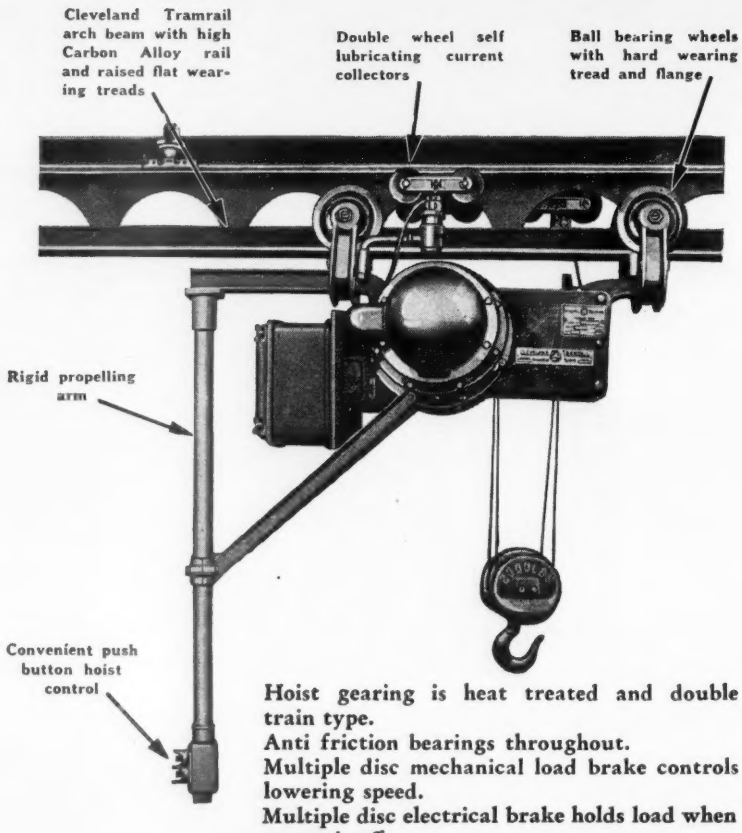
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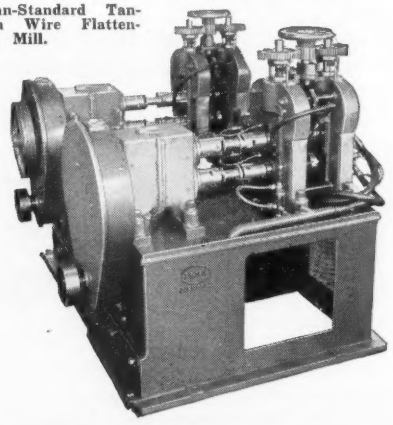

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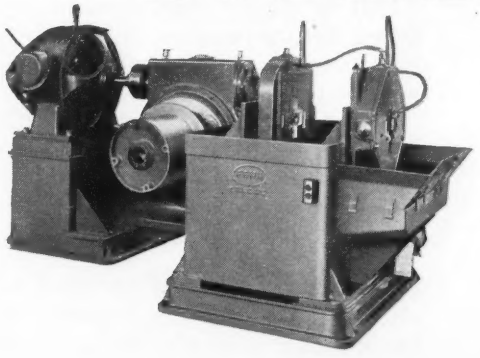

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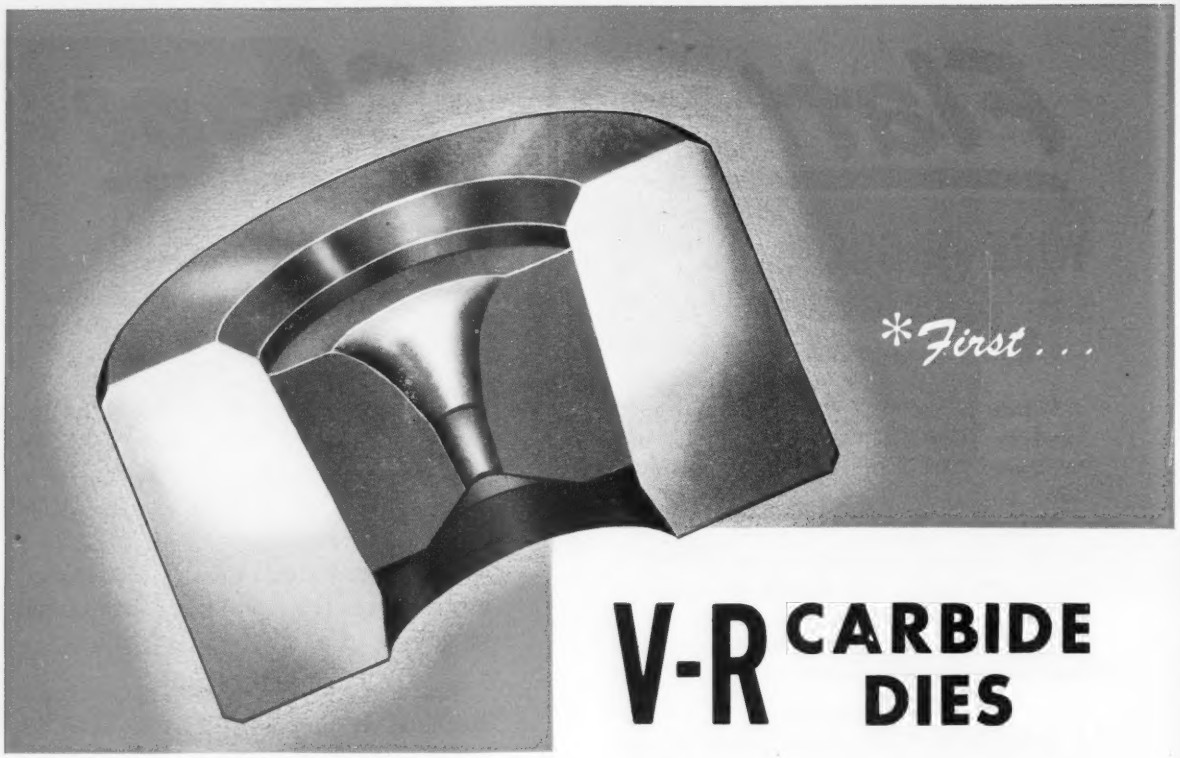

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The Wire Outlook

Estimates on steel production this year place output at as good or better levels than in 1949, when 77,250,000 net tons were turned out. The first half should account of 48,000,000 tons, which will mean running close to capacity.

The President's budget proposals would be disturbing if it were felt that Congress were disposed to go along with him. Actually, Washington observers feel that the Administration would be greatly embarrassed if its program were carried out. Many of the demands are considered to have been made for vote-getting purposes, so that at election time the "Fair Dealers" can again point an accusing finger at the Republicans.

A 42 billion dollar budget running over 5 billions more than Federal income would only increase the inflationary trend. Mr. Truman talks of an ever growing national income. While taxes remain high and Federal expenditures continue to expand, there can be no increase in the true wealth of the nation. New wealth comes from increased production per worker and certainly not from a greater income resulting from inflationary policies. More dollars in a corporation's till or in a consumer's bank account are meaningless if they can't buy more of the products of industry.

One problem to which industry might well devote greater attention is the cost of distribution. Ways and means of getting products from factory to consumer at lower costs can and must be found if business is going to be able to offset some of the rising costs. Production efficiency is at a relatively high level, although not at a peak by any means, leaving distribution (selling and transporting goods to markets) as the one opportunity for major cost savings.

Copper supply is tied closely to the general level of business, so it is not surprising that copper supplies are tight. Domestic producers last year delivered 896,000 tons of copper to fabricators, whose total purchases were 1,148,000 tons. Of this 170,000 was for stockpiling. Imports made up the difference.

Aluminum production in 1949 was in excess of 1,200,000,000 pounds, which was some 40 million pounds under 1948 due to the slack midyear period and to labor troubles. This year both supply and demand are expected to exceed that of 1949.

Brass Mill products have been in heavy demand and, in anticipation of continued good business, the mills are pressing for greater supplies of billets from basic producers.

Wire buyers are expecting higher prices and accordingly have been trying to lay in as much as possible before prices advance.

Fastener producers are getting orders in good volume. Heading wire is in excellent demand. Upholstery wire buying has slackened, but orders for deferred tonnage is good. Spring wire is being booked for four months delivery while manufacturers' wire and merchant wire orders are being taken for two to three months delivery.

1950 is going to be a good year volume-wise, but is going to present many problems to business, large and small, as it tries to adjust itself to the new worker-benefits and to higher price levels.

However, every recent year has had serious headaches and by this time most business men are inured to the extra burdens of work and the hazards of doing business foisted upon them by a rapacious Treasury Department under pressure from an extravagant Administration.

This doesn't mean that we should take it lying down, but more than ever use every means within our power as individuals to make our ideas apparent to our Federal representatives.

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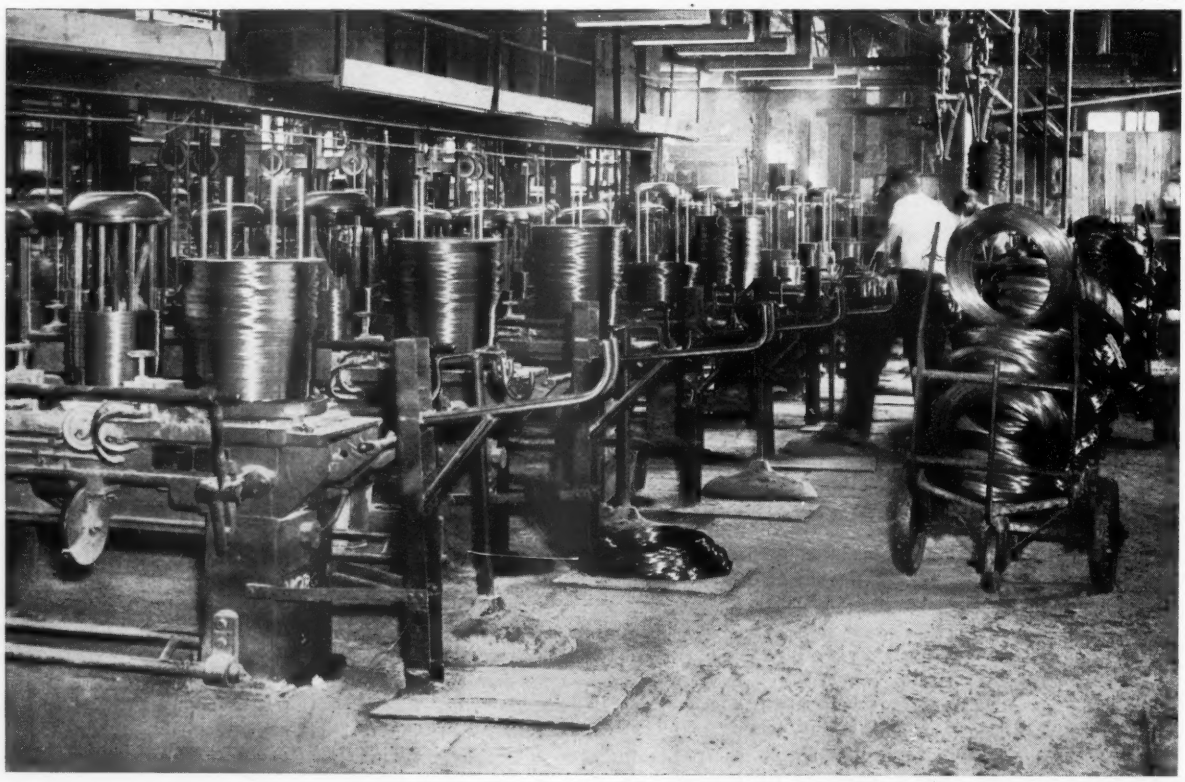

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Vol. 25 FEBRUARY, 1950 No. 2

Designated as

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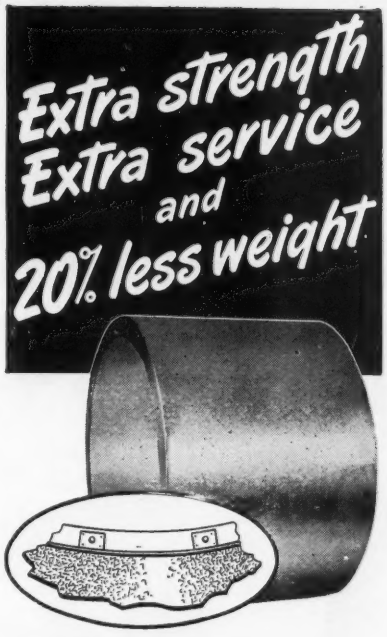

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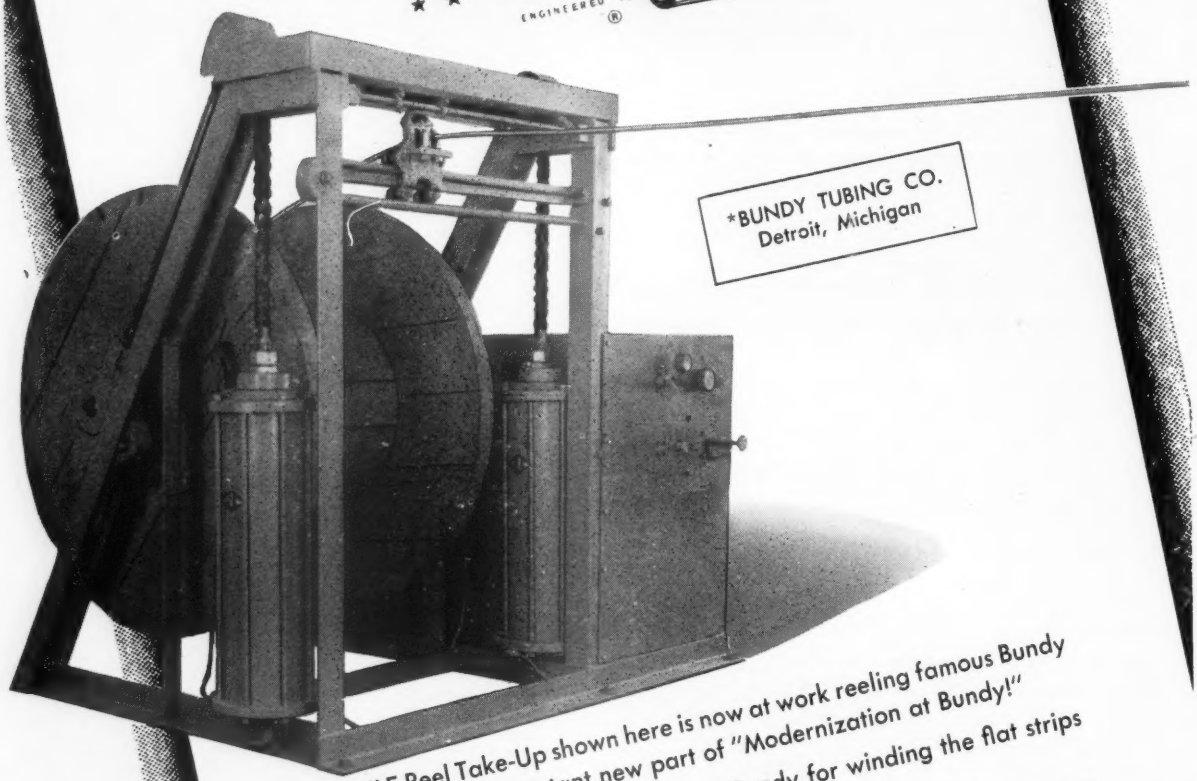

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Vol. 25 FEBRUARY, 1950 No. 2

An Investigation Of The Weavability Of Wire With Observations On The Defects Of Wire And Wire Cloth

By WALSTON CHUBB, Jr.

Perrysburg, Ohio

Part I

This study is the result of research work carried on at the Missouri School of Mines under the Ludlow-Saylor Company's research fellowship there, now in its third year. The objective is to enable suppliers to furnish better wire and wire cloth buyers to secure the highest quality of product. The first fellow was E. W. F. Funk, whose work is referred to by the author and from whose researches he benefited. The work was carried on under the direction of E. S. Epplesheimer, head of the Department of Mechanical Engineering. This paper is being published in four installments of which this is the first part.

INTRODUCTION

Definition of Objectives

IN the course of this year's work under the auspices of the Ludlow-Saylor research fellowship many problems of interest to the wire weaving industry have been investigated. Some of these problems have no academic novelty; others were not completed and have been laid aside for future investigations. The major problem for investigation this year was to discover a method by which the weavability of wire might be evaluated. A second problem for investigation was to discover the causes of some of the defects of wire and wire cloth.

★ ★ ★

IN addition to presenting the results of these investigations, this thesis represents an attempt to compile, in an orderly fashion, some of the background material that has been obtained by the author in the last year with regard to wire and the weaving of wire. It should be pointed out that the presentation of this thesis is complicated by having to be intelligible to two audiences; it should make the mechanical problems of the wire weaving industry intelligible to the metallurgist, and it should make the vocabulary of metallurgy intelligible to the wire weaver. So as not to interrupt the narrative with lengthy explanations of certain subjects, references to more detailed discussions of these subjects are given in the text, and a glossary of terms is included in the appendix. Numbers in parentheses at the end of a sentence or paragraph refer to references listed in the appendix. These references are the sources of material for and contain more detailed accounts of the subjects discussed in this thesis.

★ ★ ★

Historical Notes

THE history of the development of the wire weaving industry is inextricably involved with the histories of two other industries: the wire manufacturing industry and the textile weaving industry. Flat gold wire was used by the Egyptians as early as 2750 B.C., and "cloth of gold" is mentioned in classical and Biblical literature[1]. It seems probable to the author that such cloth was only a fabric decorated with interwoven threads of flat gold wire, and was not a cloth woven entirely of gold wires; however, the principle of weaving of wire was there.

★ ★ ★

DIES were introduced into the wire industry sometime before 1000 A.D. At first, dies were used only to round up hammered wires and to polish off the bumps and burrs. Just when the discovery was made that wire could be elongated by drawing it through a die is not known, but records are available to show that wire was being drawn on a commercial scale in France about 1270 A.D. Rudolph of Nuremberg is usually credited with having introduced the art of wire drawing into Germany in 1351[1].

★ ★ ★

HAMMERED wrought iron wire was produced for chain armor sometime during the Middle Ages, and some wrought iron was being drawn into wire even before the appearance of Bessemer steel in 1860. According to Camp and Francis, the first wire mill in the United States was built at Norwich, Connecticut, in 1775. With the advent of steel and steel wire, the wire drawing industry in the United States grew rapidly until now there are more than 3,000,000 tons of steel used in the wire industry annually, and some 150,000 different products are produced from wire [1]. Of these products, the most important to the early wire industry and to the history of the United States was ordinary barbed wire, which was developed by a group of mid-Westerners between 1867 and 1874, [2].

★ ★ ★

THE art of textile weaving antedates recorded history, but technological advances in textile weaving began with the invention of the flying shuttle in 1733 and the invention of the power loom in 1785. By 1815 power looms were firmly established in the textile industry, but, according to the **Wickwire-Spencer Steel Company**, it wasn't until 1857 that the first power loom for weaving wire cloth was invented by a worker of the **Clinton Wire Cloth Company**, [3].

★ ★ ★

JUST one year prior to this invention, in 1856, Mr. **R. C. Ludlow** established the **Ludlow Wire Works** at 215 Market Street in St. Louis, Missouri. This retail store and factory produced wire cloth and wire screen specialties on hand looms and benches, and the products were sold in the front office. In 1859, Mr. Ludlow changed the name of his company to the Premium Wire Works and in 1869 to the Great Western Wire Works. The Great Western Wire Works was relocated in more commodious quarters at 219 Market Street.

★ ★ ★

IN the early 1860's Mr. **O. P. Saylor** established the **Saylor Wire Works** at 116 Market Street. In 1868, he was joined by Mr. J. T. Demoss and the company became known as O. P. Saylor and Company, Empire Wire Works. In 1870, the Great Western Wire Works and the Empire Wire Works were consolidated into **Ludlow, Saylor and Company** at 219 and 221 Market Street. And in 1875 this enterprise was formally incorporated as the **Ludlow-Saylor Wire Company.**

★ ★ ★

IN 1883 this company built a factory at 116 South Fourth Street where they installed power-driven looms. These looms were in operation by 1886. In 1900, the company again felt the need for more room, and the looms were moved to the site of the present plant at 600 South Newstead Avenue, St. Louis. Since 1900 operations at the Fourth Street store have ceased entirely, while the plant on South Newstead has been expanded several times.

★ ★ ★

BECAUSE of the strength, stiffness, and weight of wire, the technology of wire weaving has lagged far behind the technology of textile weaving. However, the phenomenal progress of the wire weaving industry during the last decade and progress in the future may soon put the two industries on a technological par. Typical of this progress was the recent installation by Ludlow-Saylor Wire Company of electronic control devices upon some of their looms.

★ ★ ★

Background Material and Review of Literature

IN order to properly investigate the problems of the wire weaving industry, the author took a position with the Ludlow-Saylor Wire Company as an assistant to their mechanical engineer during the summer of 1948. This experience was an invaluable asset to this year's research work, and much of the material in this thesis with regard to the weaving of wire and the defects of weaving wire was obtained at that time. However, in order to more completely understand the properties and defects of wire as they appeared in the factory, the author found it necessary to review the literature with regard to the manufacture and testing of wire. The author feels that some of this material should be included here because of its bearing upon the nature and defects of weaving wire.

★ ★ ★

The Production of Wire

THE metals and alloys most commonly used for the production of weaving wire are plain-carbon steel, brass, monel metal, stainless steel, bronze, phosphor bronze, copper, aluminum, and nickel. Of these metals, the plain-carbon steels greatly exceed any of the others in tonnages used by the wire weaving industry. For this reason, the author limited his investigations this year to the plain carbon steels, particularly to the low carbon steels.

★ ★ ★

PRACTICALLY all grades of carbon steel have been and are being used in the wire industry, but the great majority of steels may be classified as either low carbon or high carbon steel. The first group comprises those steels containing less than approximately 0.20 per cent carbon; and the second group comprises those steels containing more than 0.45 per cent carbon. According to B. L. McCarthy, steels of intermediate compositions are somewhat more difficult to draw into wire, [4].

★ ★ ★

LUDLOW-SAYLOR Wire Company uses 0.05 to 0.08 per cent carbon steels for those grades of weaving wire that must be fully annealed and extremely soft and pliable. It uses 0.45 to 0.60 per cent carbon steels for the hard drawn, high strength grades of weaving wire. And it uses 0.05 to approximately 0.20 per cent carbon steels for its hard drawn wires of intermediate strength and stiffness.

★ ★ ★

IT is not commercially practicable to hot roll steel rods to sizes much less than one-quarter inch in diameter; and therefore, practi-

cally all sizes of wire smaller than one-quarter inch are cold drawn, [1]. Cold drawing of steel wire increases its elastic limit and tensile strength and decreases its plasticity and ductility. The ability of cold drawing to increase the elastic limit and tensile strength of wire is one of the fundamentals of modern wire drawing practice. The manufacturer is limited only by the strength of the annealed or patented wire and by the maximum strength that he can produce in a wire without breaking it during drawing. Formulas for calculating the strength of steels in the hot rolled, full-annealed, and patented states are given in the literature, [5], [6], [7]. Starting with a steel of a certain composition and a certain strength, the wire manufacturer can produce a great variety of products just by controlling the amount of cold reduction that is given to the wire. Cold drawing may increase the tensile strength of some grades of wire by more than 100,000 pounds per square inch. Charts showing the effect of cold drawing upon the tensile strength of most grades of steel are given in the literature, [6], [7], [8].

★ ★ ★

ALTHOUGH, according to J. G. Weiss, [7], an almost linear increase in tensile strength occurs with cold reductions up to about 80 percent, very little change in the structure of steel can be observed until a reduction of 20 to 30 percent is achieved, [1]. Figure 1 shows a longitudinal section of a low carbon steel wire in the fully annealed condition. Figure 2 shows a longitudinal section of a low carbon steel wire that has been subjected to many heavy cold reductions. These photographs illustrate how the nearly equiaxed grains of an annealed specimen become oriented and elongated during cold drawing operations.

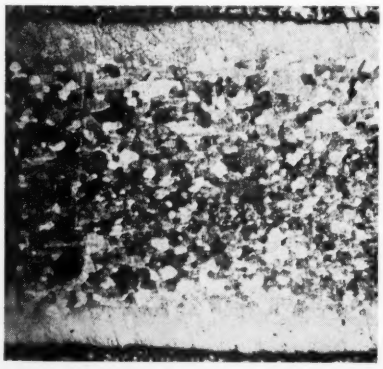

Fig. 1—American, 22 gage, Ludlow specifications (low carbon) weaving wire, fully annealed. Longitudinal section, magnified 100 times. Nitol etch. Knoop hardness: 117.

★ ★ ★

ALMOST all the wire used by the wire weaving industry is either hard drawn or fully annealed. According to Herbert Chase, the five, "hardnesses" of wire are: No. 1, "Hard"; No. 2, "Half-Hard"; No. 3, "Quarter Hard"; No. 4, "Pinch Pass"; and No. 5, "Dead Soft." "Dead soft" wire is usually fully annealed wire, [9]. These various hardnesses of wire are obtained by the wire manufacturer by using process annealing and patenting in conjunction with controlled amounts of cold reduction.

★ ★ ★

FULL annealing or "annealing" is a process which involves heating steel wire to a temperature of about 1350 degrees Fahrenheit and allowing it to cool very slowly. Full annealing is especially important as a finishing operation in the production of "dead soft", low carbon steel wire, [1]. In order to produce a uniform "dead soft" anneal, it is necessary to heat all parts of a strand or coil of wire at a uniform rate to the same ultimate temperature above the critical range, to hold it there for a fixed length of time, and to cool it at a uniformly slow rate. According to Paschkis and Doyle, it is impossible to attain these ideal conditions in commercial practice as in pot or box annealing, [10]. In 1942, Mr. L. D. Granger reported that non-uniformities in annealed steel weaving wire could be traced back to irregular heating of the wire in the box annealing operation, [11].

★ ★ ★

THE finishes commonly obtained on steel wire used by the wire weaving industry are (a) blue-black, (b) bright, (c) liquor finish, (d) coppered, (e) tinned, and (f) galvanized. A blue-black finish is obtained on annealed wire that has been fully annealed in an open or unsealed pot. A bright finish is obtained on hard drawn wire and on annealed wire that has been annealed in a sealed pot under a protective atmosphere. A liquor finish is obtained on wire that has been dipped in a solution of copper and tin salts. A coppered or tinned finish is obtained by dipping the wire in a solution of a copper or tin salt. None of these finishes or coatings have any great corrosion resistance, and, hence, where corrosion resistance is desired, hard drawn or annealed wire is galvanized, [1], [12].

★ ★ ★

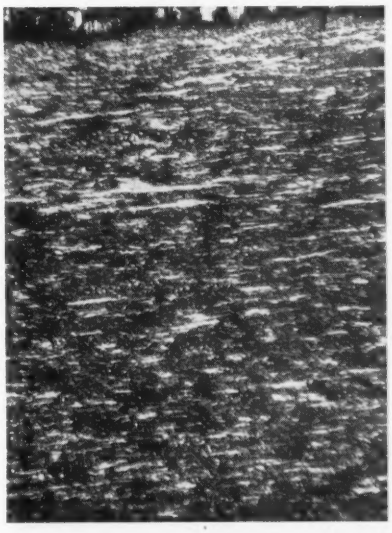

Fig. 2—Republic, 14 gage, low carbon, steel weaving wire, hard drawn. Longitudinal section, magnified 100 times. Only one half of the section appears in the photograph. Nitol etc. Knoop hardness: 218.

WIRE sizes in the wire weaving industry are customarily given according to the Washburn and Moen gage number. Some size tolerance is absolutely necessary because it is impossible to draw wire perfectly round and uniform in size even with the best modern equipment. Fortunately, size tolerances in the wire weaving industry are most generous; according to several loom operators at Ludlow-Saylor Wire Company, variations of one-quarter gage from a nominal gage size have practically no effect upon the wire weaving operation. This circumstance allows tolerances somewhat more liberal than the "regular size tolerances" listed by Herbert Chase, [9].

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OF the steel wire consumed by Ludlow-Saylor Wire Company, the greatest portion is used as fully annealed, low carbon steel wire in sizes ranging all the way from one inch rounds to wires less than 0.010 inch in diameter. The next greatest amount consumed is used as hard drawn high carbon wire in sizes down to about 20 gage. According to the tonnages used by Ludlow-Saylor Wire Company, the most important sizes of weaving wire are: 5/16 inch wire, 3, 6, 10, 11-14, 16, 18, 20, 22, 24, 28 gage wire, 0.012 inch wire, and 33 and 39 gage wire.

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Testing of Wire

EVEN though most wire undergoes rigorous inspection during the processes of manufacture, inevitably some defective wire is produced. In order to weed out such wire, many wire purchasers require that their wire be more or less thoroughly sampled and tested. Wire samples are taken from the ends of coils selected from a shipment of wire, and these samples are subjected to those tests which best indicate the properties that the customer requires.

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OF all the tests performed on wire, the tensile test is probably the most widely used. In this test the specimen is mechanically stretched until it breaks. The maximum stress required to break the specimen is called its "tensile strength." The difference in length between the broken specimen and the original specimen is called the "elongation", and it is usually expressed as a percent of the original length. During tensile tests on low carbon steel wire, two distinct periods are observable; the first is called the elastic range, and the second is called the plastic range. The point of demarcation between the elastic range and the plastic range is known as the elastic limit or yield point, [13].

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IN the tensile testing of wire, the author has used specimens with a ten inch "gage length" of wire between the jaws of the testing machine, but other lengths are used. The tensile testing of fine wire requires a machine designed to measure loads of only a few pounds and requires special grips for holding the wire. Ordinary jaws with serrated faces are unsatisfactory for fine wire because they cut the wire. One type of grip used by the author for testing fine wire consists of a clamp and a large peg mounted on a piece of plate steel. A fine wire may be wound around the peg several times and clamped to the mount; then the whole mount may be attached to a tensile machine.

★ ★ ★

ANOTHER test commonly applied to wire is the hardness test. Hardness tests are usually performed with special machines such as the Rockwell hardness tester or the Tukon hardness tester. The author used the Tukon hardness testing machine for determining the hardness of his wire specimens. This machine presses a diamond point into the metal and the size of the impression is measured with a microscope. This measurement is then converted mathematically into the Knoop hardness number, which is directly proportional to the hardness of the specimen.

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OTHER tests commonly applied to wire are reverse bend tests, wrap tests, torsion tests, and fatigue tests, [14], [15]. Some of the other tests that may be applied to wire are knot or kink tests, actual forming tests, stiffness tests, nick and break tests, reverse torsion tests, wear tests, corrosion tests, surface inspections, chemical analyses, and metallographic examination.

★ ★ ★

Metallography of Wire

WHEN a small specimen is to be examined by polishing and etching, it is usually mounted in some sort of fusible alloy or plastic material that will set hard. In the mounting of steel, the mounting process should not require temperatures in excess of 300 degrees Fahrenheit. Slight structural changes occur in hardened steel when it is heated to temperatures as low as 300 degrees Fahrenheit, [16].

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BAKELITE and Wood's metal were the two mounting media used by the author, but each was found to have certain disadvantages. In mounting wire specimens, it was thought desirable to have both a cross section and a longitudinal section of the wire appear in the same mounting. To accomplish this with a bakelite mounting and still have the wire securely held, it was found necessary to place two right angle bends in the wire so as to form a square bottomed U shape; then the legs of this U were bent in the middle through a 180 degree angle so as to project well below the bottom of the U; then these projections had to be bent over at a 90 degree angle so that the U would stand upright in the bakelite mold. After the specimen was mounted, a rather large amount of bakelite had to be ground away so as to expose the bottom of the U as a longitudinal section. This was a slow operation, especially with heavy wires.

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MOUNTING in Wood's metal was accomplished in much of the same manner, except that the last 90 degree bend in the specimen was not necessary; the wires projecting below the U were stuck into a piece of plasticine, a half inch length of copper tubing was placed around the specimen, and Wood's metal was poured into this mold. The resulting mount required that only a small amount of metal be ground away before the longitudinal section of the wire appeared. The great disadvantage of using Wood's metal was the difficulty experienced in trying to etch specimens mounted in it. When a steel specimen mounted in Wood's metal was etched, the alloy mounting was attacked as well as the steel, and dissolved lead tended to re-deposit on the steel by cementation. As a result, it was found to be almost impossible to

properly etch fine steel wires mounted in Wood's metal. For these reasons, the author believes that it is best to mount fine wires in bakelite and heavy wires in Wood's metal, [17], [18].

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IN order to prevent rounding off the edges of wire specimens, it was found necessary to polish the specimens by hand on emery paper. The specimens were polished on emery papers down to four zeros fineness and then finished with alumina. All specimens were etched with two percent nitol solution.

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EXCEPT for a few micrographs taken at a magnification of 175 diameters, all metallographic specimens examined this year were photographed at the ASTM standard magnifications of 50x, 75x, 100x, 150x, 500x, and 750x, [19].

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Weaving of Wire Cloth

WEAVING is a process of interlacing wires or threads so as to produce cloth; the most common form of cloth consisting of two systems of wires or threads at right angles to one another. In the weaving of all kinds of fabrics, one of these systems, called the woof or fill, is made to pass alternately over and under the other system, called the warp. The essential operations are the successive raising of certain warp wires or threads and the depression of others by means of harnesses so as to form an opening for the passage of the fill wire or thread. When a new fill wire has been laid in this opening, the opening is closed by lowering the warp wires that had been raised and raising those that had been lowered; this enmeshes the fill wire, which is then beaten up into the cloth by means of a heavy reed or beater, [20].

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THE major differences between wire cloth looms and cotton cloth looms are the result of the superior weight and stiffness of wire; the wire cloth loom must be more powerful and more rugged, and in many cases the wire must be precrimped so that it can be properly woven into cloth. The various types of looms used at Ludlow-Saylor Wire Company may be classified under three general headings: (a) the bench type looms that weave wire so heavy that both the warp and the fill must be pre-crimped; (b) the double-crimp type looms that use pre-crimped fill wires, the warp wires being crimped by the action of the loom; and (c) the bobbin and shuttle type looms in which both the warp and the fill are crimped by the action of the loom. This last type of loom is limited to very light wires or to large opening cloth. Figure 3 is a photograph of shuttle type loom. It should be pointed out that

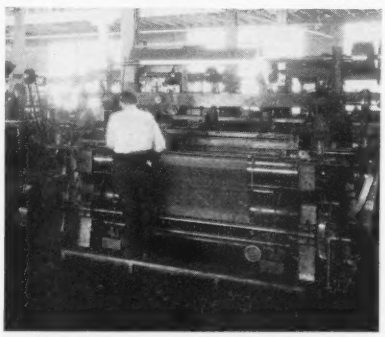


Fig. 3—Shuttle type wire weaving loom. * *

straight-warp cloth may be woven on all of these looms, and this fact does not necessitate any change in the above classifications.

★ ★ ★

IN describing wire cloth, the type of weave, the warp count, the fill count, the warp wire size, and the fill wire size must always be given. Once this information is given, then the size of the openings in the cloth is fixed. The number of openings per inch is known as the "mesh" of a wire cloth; the number of warp wires per inch is known as the warp count or mesh, and the number of fill wires per inch is known as the fill count or mesh. The size of the openings in a wire cloth depends upon the number of openings per inch and upon the size of the wires that border these openings, [21], [22]. The most important varieties of weave used by Ludlow-Saylor Wire Company are plain weave-square opening, plain weave-rectangular opening, plain Dutch weave, and twilled Dutch weave, [22], [23]. For square opening cloth, the maximum mesh count is limited by the size of wire used; a wire must be crushed during crimping or weaving in order to reduce the opening to less than the wire diameter.

★ ★ ★

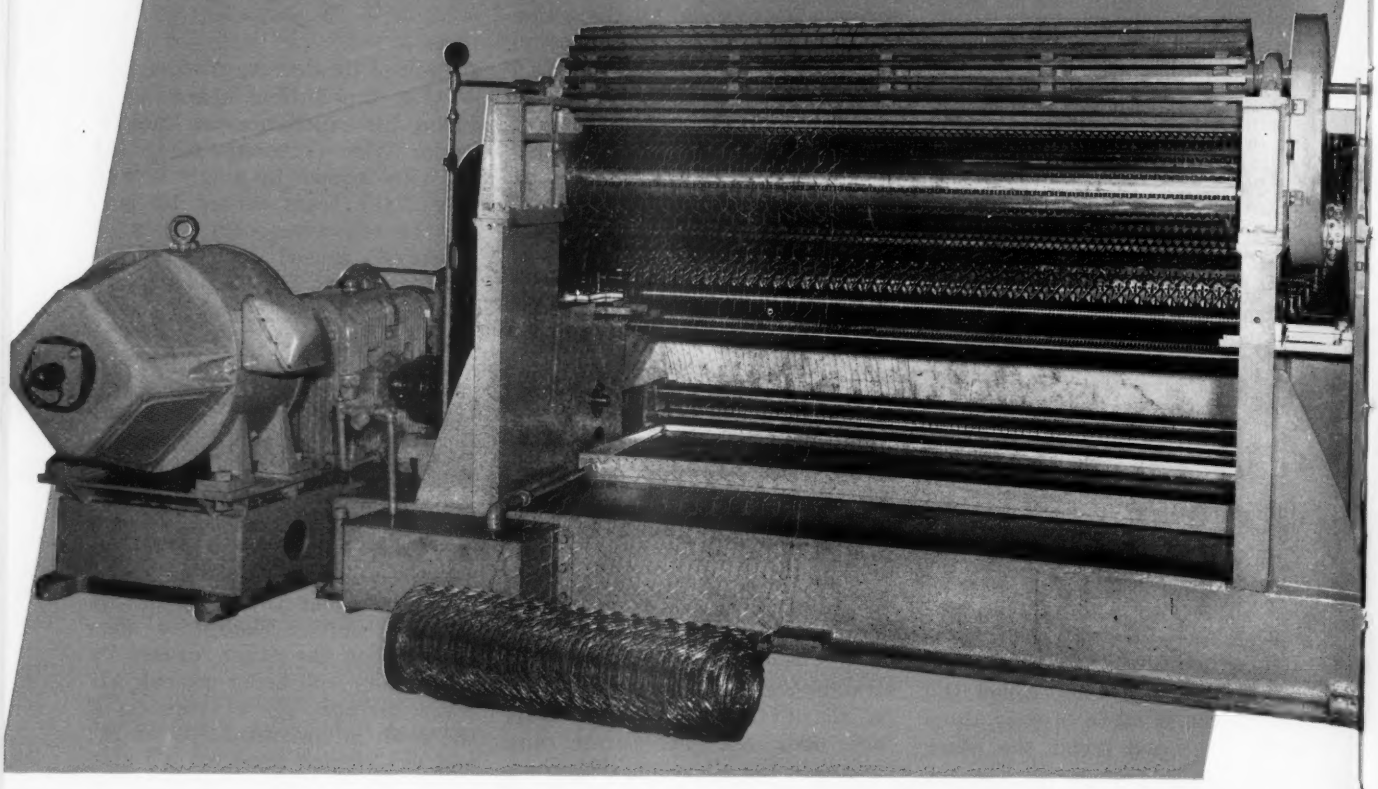
SOME of the defects of wire cloth that the author heard about during his experiences at Ludlow-Saylor Wire Company were: (a) pin holes caused by single broken wires; (b) tears caused by several broken wires; (c) knots or "hickeys" caused by kinked or twisted wires; (d) curved wires, uneven mesh, bumpy surface, and patchy color caused by irregular annealing, [24], [25]; (e) periodic marks on the cloth caused by a worn loom, [25]; (f) "spring" or spontaneous lengthwise coiling of the cloth caused either by a vertical component in the beating-up of the fill wires or by unsymetrical motion of the heddles; (g) loose or "sleazy" cloth caused by overcrimping either the warp or the fill; (h) curved cloth, one edge longer than the other, caused by the take-up roll being conical; (i) wavy surface; (j) a tendency of the cloth to curl across its width; and (k) rippled edges.

★ ★ ★

MANY of these defects suggest their own cures, but some require further investigation. Spontaneous coiling of wire cloth may be minimized by pulling the cloth over a dull knife edge under just sufficient tension to eliminate the tendency to coil; a "breaker bar" is used on some looms to do this during the weaving process. A wavy surface on cloth is minimized by placing flat steel bars over and under the cloth just at the weaving line on a loom, but the cause is unknown. The tendency of cloth to curl across its width is known as the "Gutter" effect, and the author has heard no explanation of the cause. Wrinkled or rippled

(*Please turn to page* 174)

NEW Wean HEXAGON NETTING MACHINE PRODUCES MORE THAN 100 FEET PER MINUTE



Wean Wire Machinery is engineered and built to give you the last word in modern, up-to-date, high efficiency equipment. Just as the pictured hexagon netting machine doubles or triples present production, so do other Wean machines — both process and product — lead the way in boosting production, lowering costs and assuring better wire products.

If you're making or processing wire and want to be sure of the best — look to Wean — pace setter in wire machinery.

Wean Equipment Corporation
CLEVELAND, OHIO

Fume Elimination For Wire Enameling Ovens

By R. J. Ruff, President
Michigan Oven Company
Detroit, Michigan

The development of a method to dispose of fumes produced in enameling wires is a matter of importance to those who engage in this work. There is some controversy on the flame impingement and water scrubbing methods mentioned but the descriptions herein are based on competent outside authorities.

IN the production of enameled wire, the solvents driven from the coated surfaces during the baking process and exhausted from the oven to the outside of the building frequently causes a local air pollution problem. Frequent cleaning of exhaust manifolds and stacks is necessary due to partial recondensation of the solvents after being discharged from the oven. The recently developed catalytic fume incinerator, capable of completely consuming the fumes in exhaust gases from wire enameling ovens, simultaneously solves air pollution and recondensate problems.

★ ★ ★

THIS discussion will be confined to the application of catalytic incinerators to the exhaust from existing wire enameling ovens. The potentialities of catalytic incineration within the oven proper, to utilize the heat energy developed, are well recognized and applications for patents on this and other catalytic combustion utilizations have been filed.

★ ★ ★

WIRE enamels normally contain cresylic acid, naptha thinners and other hydrocarbons, which, upon vaporization in the baking process, give off a noxiously characteristic odor. It is not unusual for a wire enameling company to receive complaints of odors from residential areas a mile or more from the plant. Occasional atmospheric down-drafts may, on the other hand, return to the enameling plant the concentrated fumes from the stack outlets, impairing the welfare and productivity of employees.

★ ★ ★

PLANTS located in isolated industrial areas may require no solution to the air pollution problem. Stacks can be constructed sufficiently tall to avoid the return of objectionable odors to the immediate plant area. However, even though the odor problem has in some manner been overcome, there remains the time-consuming, periodic-cleaning of accumulations in the exhaust hoods, manifolds and stacks. The fumes, upon leaving the oven, become cooled as they enter the exhaust system, and a portion of the volatiles recondense and remain inside the ducts. As they accumulate, a serious fire hazard develops and only frequent shut-downs for cleaning assures safe operating conditions.

★ ★ ★

Other Methods

SEVERAL methods of fume elimination, other than catalytic combustion, have had limited usage in the wire enameling industry. Flame incineration is used in several plants. With this method the oven exhaust gases are carried through a refractory combustion chamber where gas burner flames impinge on the gas stream. Reports indicate that complete combustion of the fumes can be obtained by this method when heating the exhaust gases to their ignition temperature, which varies between 1200 deg. and 1400 deg. F. It is evident, therefore, that to obtain complete flame incineration requires substantially more fuel than is required to operate the oven. The provisions necessary to handle the hot effluent gases add materially to installation and maintenance costs.

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Water scrubbing of exhaust gases is also used in several wire enameling plants. Here, the fumes after leaving the oven pass through a water spray, or under an inverted weir to come into intimate contact with the water particles. The cooling effect causes the volatiles to condense and drop out of the air stream into the water. With added equipment and cost, the solvents can be reclaimed. Otherwise, the solvents must in some manner be collected and disposed of. It is generally recognized that the water scrubbing method collects only part of the hydrocarbons in the exhaust stream.

★ ★ ★

Principles of Operation

BY catalytic incineration, no added energy whatever is necessary to obtain complete incineration, provided the fumes in the oven exhaust manifold are at a temperature of 500 deg. F. or higher. The process simply converts the existing potential energy of the fumes to heat energy.

★ ★ ★

AS the name implies, the incinerator employs a catalyst to promote combustion of the hydrocarbon fumes. A catalyst, by definition, is a substance whose presence accelerates a chemical reaction without in itself entering into the end product. So, in the incinerator, when gases containing a mixture of vaporized hydrocarbon and air at a temperature of approximately 500 deg. F. or higher come into intimate contact with the catalyst, the hydrocarbons and the oxygen of the air combined to form

the usual products of complete combustion, namely, water vapor and carbon dioxide, with heat liberation. There is no addition to, or detraction from the catalyst. The presence of the catalyst merely reduces the auto ignition temperature of the fumes to approximately 500 deg. F.

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THE heart of the catalytic fume incinerator is the catalyst "element" which has the appearance of a metallic air-filter mat. Mounted on an alloy frame, inner and outer container screens are separated by ½" to 2" of catalyst media. The media is designed to produce a very high surface area and to cause turbulence to the exhaust stream as it passes through the mat to obtain intimate contact of the fumes with the catalyst surface. Combustion occurs on the surface of the media, resulting in a temperature rise to the media, with the heat then liberated to the exhaust stream. Since the fume concentration is so low as to prevent flame propagation, there is normally no visible evidence of combustion. Where fume concentrations are sufficiently high, the heat of combustion will cause the catalyst to come to a dull-red heat. The materials used in the element are suitable for sustained operation above 1200 deg. F.

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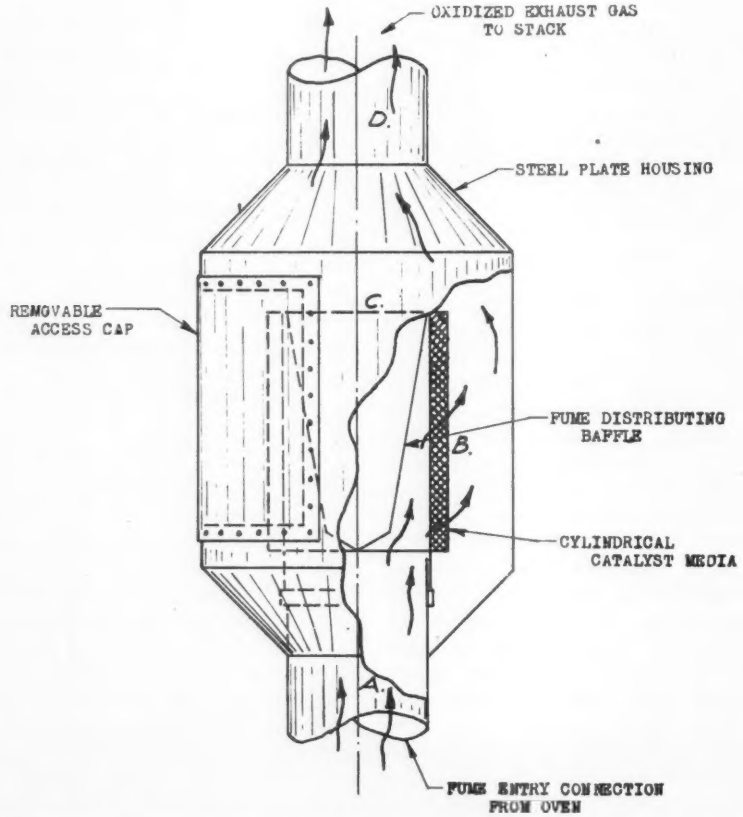
IN appearance, the complete catalytic fume incinerator for a wire enameling oven is extremely simple, having no moving parts or utility connections. The figure below illustrates a typical unit. The exhaust gases, after leaving the oven, enter the incinerator housing at "A" at a temperature of approximately 500 deg. F. or higher. The gases then are made to pass through the catalytic element "B," cylindrical in shape, with capped end, "C." After combustion of the fumes is completed in the element "B," the gases are again collected to be discharged into the outside stack connection, "D." A cylindrical mat is illustrated for its ease and convenience in mounting into existing duct work. However, flat, rectangular element mats have also been constructed for mounting into rectangular exhaust manifolds. The latter arrangement is particularly adaptable to those installations where the exhaust manifold temperature is below 500 deg. F. A line-type gas burner can conveniently be installed in advance of the catalyst to permit the necessary preheating to the auto-ignition temperature.



Catalytic Fume Incinerator

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Operating Results

THE initial installation of the catalytic fume incinerator was made during the early part of 1949 on an oven baking Formvar enamel. In appearance the incinerator is similar to that shown on the figure herewith. Thermocouples mounted in the entry and discharge throats of the catalyst housing record the temperature rise through the incinerator. This unit has now been operating in excess of 2000 hours, during which time it has required no maintenance or attendance time. The stack on the discharge side of the catalyst housing has remained clean, and there are no detectable odors or color issuing from the stack. The entry temperature to the catalyst housing has varied between 490 deg. and 510 deg. F. while the discharge temperature operates at 850 deg. F. to 950 deg. F. depending upon wire size and speed.

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THEORETICAL investigations indicate the maximum temperature that can be expected from the discharge side of the incinerator when installed on a wire enameling oven. Insurance underwriters specify for oven design a minimum ventilation equivalent to 10,000 cubic feet of 70 deg. F. air for each gallon of solvents volatilized. Under these conditions, the temperature rise through the catalyst would approximate 600 deg. F. Consequently, under minimum

(*Please turn to page* 172)

Symposium on Tungsten Carbide Dies

(Panel Members' Names on Page 141)

A Symposium presented before the Wire Association during the Annual Convention in Chicago, Illinois, October, 1949.

E. J. Crum, (Chairman)

THE subject this morning is a symposium on tungsten carbide dies. In order to get a complete story on all phases of the tungsten carbide die, it was thought best to set up a theoretical mill drawing various sizes and shapes of wire. From this, a definite plan will be laid out to properly set this mill up with a die room, equipment, methods of handling dies, personnel, and servicing of dies to efficiently and economically operate this theoretical mill.

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I THINK we are fortunate in having as members of the panel to discuss this subject six men whose experience totals over 100 years of active work in the carbide die field. Three of these men represent firms that fabricate tungsten carbide dies and the other three men represent plants that use tungsten carbide dies to a large extent. May I present . . .

E. Duthaler—Jones & Laughlin Steel Corp.

A. Hedman—Colorado Fuel & Iron Corp. - Wickwire Spencer Steel Division

G. Fecsen—Pittsburgh Steel Co.

E. Henry—Vascoloy Ramet Corp.

E. Miller—Firth Sterling Steel Corp.

W. Schofield — Carboloy Company, Inc.

★ ★ ★

IN setting up a wire die room we first must know the following:

1. Tonnage of wire the mill is to produce.
2. Range of wire sizes broken down per tonnage.
3. Types of die servicing equipment needed.

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LET us assume a theoretical wire mill which is to produce 10,000 tons of steel wire monthly. The daily production requirements of this mill are as follows:

.015″ dia. and smaller	5 tons daily
.015″ dia. to .040″ dia.	50 tons daily
.040″ dia. to .118″ dia. (Including Shapes)	300 tons daily
.118″ dia. and over inc. shapes	145 tons daily
DAILY REQUIREMENTS	500 tons daily

This is typical of any fairly large steel wire mill and includes a full range of sizes. Let us also assume that overall conditions in this mill, which may have a direct bearing on die life are well controlled, i.e., cleaning, coating, lubricants, etc. Having established the above, we can now lay out our die room for this Wire Mill.

★ ★ ★

G. Fecsen

FIRST, let us consider the types of equipment we will require to make and service our dies.

Dies ranging in size from the smallest to .040″ diameter usually will require work performed on the . . .

1. 10-Spindle Driller
2. Semi-Automatic Polisher
3. Running Head

Dies over .040″ diameter and up to .250″ diameter require work on the . . .

1. Heavy Duty Ripper
2. Semi-Automatic Polisher
3. Running Head

★ ★ ★

E. Duthaler

DIES over .250″ diameter are usually reworked by boring with diamond tools on a . . .

1. Bench Lathe, or, Small Engine Lathe
2. Flexible Shaft

Shaped dies can be made using only a minimum of special equipment. A Shape Die Sizing Machine, a small Atlas Shaper, a Flexible Shaft, A Die Shaping Machine, and a standard bench vise are adequate.

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E. J. Crum

NOW let's determine the amount of this equipment we will need to take care of our die requirements. Let us first find out what our die requirements will be. Perhaps one of our die suppliers will give us estimates on die life per size.

★ ★ ★

E. Miller

THE figures we usually use as a rough estimate of die life are as follows:

.006″ dia. thru .016″ dia.	900 Lbs.
.016″ dia. thru .040″ dia.	6,000 Lbs.
.040″ dia. thru .105″ dia.	20,000 Lbs.
.105″ dia. thru .187″ dia.	100,000 Lbs.
Over .187″ dia.	250,000 Lbs.

Average Over Range
Average Over Range
Average Over Range
Average Over Range
Average Over Range

These figures can only be estimates since other conditions directly affecting die life are quite variable.

★ ★ ★

G. Fecsen

AGAIN estimating from our production requirements and our expected die life, we can come fairly close to a figure representing the number of dies to be reworked

during a 24-hour day. In this case 500 dies is reasonable.

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E. J. Crum

WE will figure on 500 dies flowing through our die room daily as a basis for establishing the amount of die finishing equipment needed. How about the number of men required to operate this die room?

★ ★ ★

Art Hedman

EXPERIENCE has taught us that one man operating two Heavy Duty Rippers and one 10-Spindle Drill can very easily produce 150 rough drilled dies in an eight hour shift. This amounts to 450 rough drilled dies per 24-hour day. This would be ample since of the 500 finished dies daily flowing out of our die room, only a half would require a rough drilling operation. By the same token we know that one man running a battery of four Automatic Polishers and one Polishing Head per shift can turn out roughly 80 finished dies in an eight hour shift. At this rate we will require seven (7) men on this work operating 12 Semi-Automatic Polishers and three Polishing Heads. These men could be divided as follows: Three men on the first shift and two on the second and third shifts. One man could handle all of the shape die work and probably could be called upon to help out on some of the other work should it be necessary.

★ ★ ★

E. J. Crum

SUMMING up now we find that we need the following equipment and personnel to operate it. . .

EQUIPMENT	PERSONNEL		
	1st Shift	2nd Shift	3rd Shift
2 Rough Rippers 1 10-Spindle Drill 1 Bench Lathe	1 man	1 man	1 man
12 Semi-Automatic Polishing Lathes 3 Polishing Heads	3 men	2 men	2 men
1 Shape Die Sizing Machine 1 Atlas Shaper 1 Die Shaping Mach.	1 man		

★ ★ ★

E. Henry

NOW to round out our personnel requirements we will need one man on each shift to service the window, and clean and inspect the dies coming in from the mill, and we will need a supervisor or foreman to be responsible for the overall operation of our die room.

★ ★ ★

W. Schofield

I DON'T feel we should skip over such things as the location of the die room, floor space requirements, lighting, and layout of equipment in the die room. As far as location is concerned there are two major factors to consider. First, that it be in a central point in relation to the wire mill so as to be equally accessible to all of the wire drawers. Second, that it be in a position to take advantage of as much natural light as possible, preferably with an eastern exposure. Our die room should be walled off from the rest of the mill and should be kept clean of dust and general wire mill dirt which may have an effect on the finish of our dies.

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E. J. Crum

HOW much floor space are we going to allot to this Die Room?

★ ★ ★

E. Henry

LET'S take a look at our requirements. We are going to operate our die room as a group of five units consisting of the following:

3 Units of 4 Semi-Automatic Polishers and 1 Polishing Head
1 Unit of 2 Heavy Duty Rippers and 1 10-Spindle Drill
1 Unit of 1 Shape Die Sizing Machine and 1 Die Shaping Machine
1 Small Shaper.

In addition to the above, we will need bench space and rack space.

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LET'S check the accompanying tentative layout and see how much space we will require. Note that as previously mentioned, the equipment has been set up in five individual units in such a way that the dies coming in at the service window flow around the room in a counter-clockwise direction as the various operations are performed upon them. They finally end up in the finished die rack again, ready for drawing wire. This particular layout seems very satisfactory for our theoretical mill and takes an area of 22′ x 30′. Adequate lighting should be provided for each work station and provision should be made to provide cabinet space under the benches. This completes all but the minor details of our Die Room.

★ ★ ★

E. J. Crum

WE now have a typical die room. Let's see how it works by following a group of dies through their various operations and back to the finished die rack.

★ ★ ★

E. Duthaler

LET'S assume a number of dies have been returned to the die room service window. The first step in determining just what has to be done to these dies is to clean and inspect them. This is the responsibility of the window attendant. You will note that adjacent to the cleaning and inspection bench there are three storage racks designated as follows:

Dies to be rough drilled
Dies to be resized and repolished
Dies to be repolished.

★ ★ ★

AFTER inspecting, the window attendant will place the dies into these racks depending, of course, upon the condition of the die. From here the dies are worked upon by the operators of the five work units and finally end up in the finished die rack. After doing his work, the operator of unit #1 replaces the die into whatever rack it now belongs and from here the operators of units #2, #3, #4, take over and complete the die. This work can be broken down in three size ranges: .006 to .040, .041 to .100, and .101 and up, if the quantity of dies warrants this system.

★ ★ ★

VERY often the window attendant will find that he has a

sufficient amount of time to be able to do all the polishing necessary on those dies needing this work, leaving only die making and die resizing for the die makers. With a die room set up along these lines and with each individual doing his job as it should be done, the dies flow without a hitch through their various operations and the die room becomes a smoothly working unit indispensable to the wire mill.

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Part No. 2

E. J. Crum

FELLOWS, we have done a good job of setting up our Die Room. Now, how about the actual methods we will use to finish and service the dies themselves? There are various ways in which tungsten carbide wire dies can be worked and finished. We will discuss, however, those methods which we feel have proven themselves over a long period of years and are generally recommended throughout the industry.

★ ★ ★

E. Henry

IN discussing finishing methods, we will group our wire dies into four categories:

1. **Dies under .035″ diameter**
2. **Dies ranging from .036″ dia. to .250″ dia.**
3. **Dies over .250″ dia.**
4. **Shaped dies.**

★ ★ ★

LET us take the groups in the above order and describe the methods and tools used in finishing the dies. Perhaps you, **Art Hedman,** can tell us about the dies under .035.

★ ★ ★

A. Hedman

RECENTLY the tungsten carbide die suppliers brought out a die that can be provided with a cored hole as small as .004 dia. This has more or less eliminated an operation previously required on fine dies. The operation referred to, of course, is piercing a hole in a blank die. In many cases this operation is still necessary so we will describe it here.

★ ★ ★

THE operation is performed on a 10-Spindle Drilling Machine and as many as 10 dies can be drilled at the same time. Hardened drill rod needles are used in conjunction with medium to fine diamond powder for this operation. The needles are ground with the same included angle as the required approach angle on the die. The action of the machine causes the lapping needles to revolve and reciprocate and at the bottom of the stroke come in contact with the preformed indentation in the die nib. The indentation is filled with diamond powder mixed with olive oil. As the die is fed upward against the action of the lapping needle, the hole becomes deeper and deeper and finally pierces through the back of the nib. By changing and regrinding the lapping needles frequently, holes as small as .0025″ can be pierced in fine dies. From this point on the procedure for finishing the pierced die is identical to the .004″ diameter cored hole methods. The next operation is to change to a finer grit diamond powder and using a newly ground needle, continue the hole through using the same method as above until a predetermined back opening diameter has been reached. At this point the die should be removed from the machine and cleaned very carefully. One particle of coarse diamond powder left in the die at this point can cause a poor finish in later operations.

★ ★ ★

THE next operation is to polish the approach angle and the bell of our die. The approach angle is polished in the Semi-Automatic Polisher using fine grit diamond powder mixed with olive oil and a pin with the correct approach angle ground on it. Here again we have a machine which embodies the use of a combination of rotary and reciprocating motion. For a die in this size range the polishing of the approach angle usually takes approximately two minutes or less. To polish the bell of the die we use a small Hi-Speed hand grinding tool with a brass lapping pin and using these in conjunction with medium grit diamond powder merely work the entire surface of the bell by hand to remove the scale and produce a good finish.

★ ★ ★

WE are now ready to cut a back relief angle in our die. Place the die in the polishing head with the back facing out. Using a steel lapping pin with the correct included angle ground on one end, work the hole up to a predetermined meeting point diameter using medium grit diamond powder and olive oil. The next step is to lap the bearing to size. We mount the die in the polishing head in the same position as in the preceding operation Our lap for this operation is a needle or music wire about .0003″ smaller than the required hole size. We taper one end of this and using fine diamond powder gradually work it into the die up the taper until the lap goes through. At this point the lap should be removed immediately otherwise an oversize hole would result. For checking the hole size we merely draw a length of wire through the die and measure it. Except for the final polish the die is completed. For the polishing, wrap a small piece of cotton around the end of a toothpick and using fine diamond powder, polish the entire working surface by hand until the required polish is obtained.

★ ★ ★

W. Schofield

ART, that's good on dies under .035. Would you use the same procedure for larger dies — say dies up to .250″ diameter?

★ ★ ★

G. Fecson

THE same principles are used in working dies of this range as are used above but the equipment is slightly different. The first operation, roughing in the approach angle, is done in the Heavy Duty Ripper. Here we use a soft steel pin that has been turned down to the correct approach angle. Using boron carbide or silicon carbide as an abrasive, we rip out the approach angle until a predetermined back opening diameter has been

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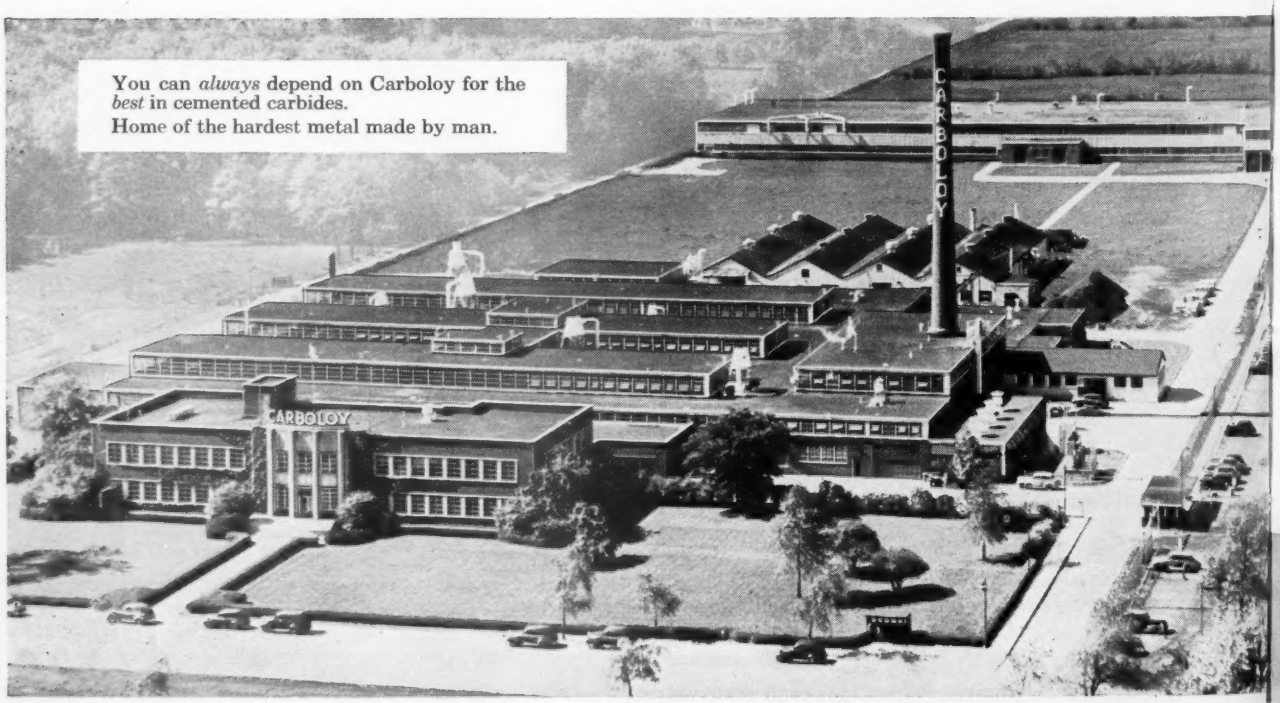
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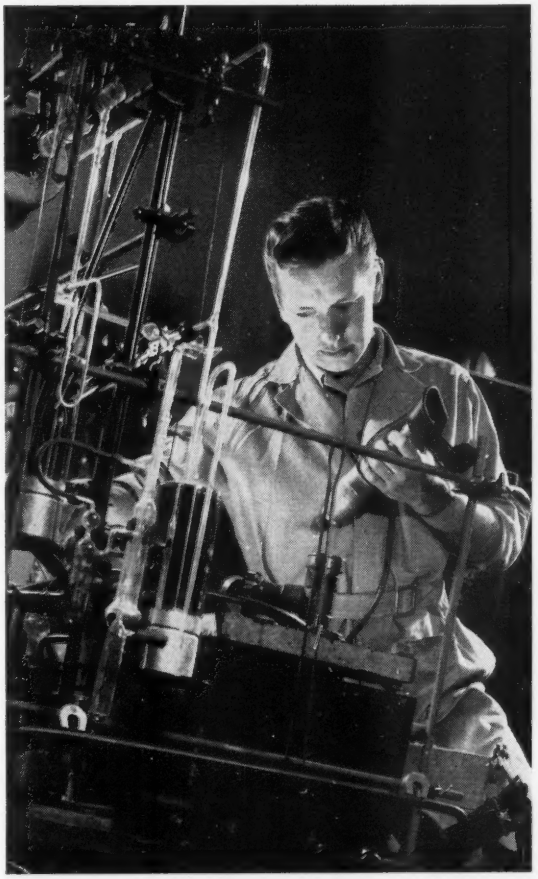

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reached. Here again we are using a machine that embodies the use of a rotary and reciprocating motion. The back relief is put into the die using the same method. The die is merely reversed in the machine and a pin with the correct back relief angle is used until the correct meeting point diameter has been reached.

★ ★ ★

THE bell and approach angle are polished and lapped in the same manner as the smaller dies using the Semi-Automatic Polisher and the Polishing Head. Now we are ready for sizing the die and here again we use similar methods. Up to approximately ⅛" diameter, we use the same type of tapered solid lap as with the smaller dies. Above ⅛" dia., the laps are made the same and then split. The split lap acts as sort of a cushion to prevent bending or sizing in the die. If a large blend is required in the die, an additional lap is used to break the corner formed by the approach angle and the bearing.

★ ★ ★

THIS lap has an included angle half the angle of the approach and is used merely to cut a small flat at the approach and bearing which is later polished to a blending radius. The polishing operation again is the same as is used on the smaller dies. Merely the use of cotton wrapped around a pointed stick with which we polish the entire working surface with fine diamond powder. Now the die is ready for use.

★ ★ ★

E. Miller

ED DUTHALER, you have had considerable experience on larger dies. Tell us about dies .250" diameter and over.

★ ★ ★

E. Duthaler

DIES in this range can be worked using identically the same method as above or by diamond boring. The diamond boring method is the faster for making an individual die. Either a diamond boring bar or diamond chips held in pliers may be used for rapid stock removal.

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THE die is placed with the approach angle facing out in a chuck or collet in the bench lathe. The first operation is to diamond bore the bearing diameter to within .005 of the finished size. In diamond boring the lathe spindle speed should be such that you get a surface speed of 100 f.p.m. on the work surface. The next operation is to diamond bore the approach angle, setting the tool compound over the required angle. If a blend is required in the die, the next operation would be to set the compound at one-half the approach angle and break the corner in the die by boring. These operations should all be done in the same setting to maintain concentricity between the approach angle and the bearing.

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NOW using a brass rod in either a flexible shaft grinder or an electric hand grinder, lap the approach angle and bell and blend the bearing and the approach angle. Start off with a coarse diamond powder and finish off with medium grit powder. Now we are ready to put in the back relief and size the bearing. To do this, remount the die with the back facing out and diamond bore the back relief at the correct angle and depth. Now we are ready to size the bearing. We use a split lap such as the type used in the preceding size range and with the die in the same position and using medium grit diamond powder, lap the bearing to size using plug gages or small hole gages for checking. For polishing the die the same methods are used as previously described, that is, using cotton covered dowel wood and fine grit diamond powder.

★ ★ ★

E. J. Crum

WELL gentlemen, are we all in agreement on how to finish round hole dies? Who would like to go into the subject of shape dies?

★ ★ ★

W. Schofield

IN making and servicing shaped dies, we use entirely different methods than those previously described. There is considerable more work involved in making a shaped die than in making a round hole die, although once the die is made, the servicing and maintenance work is comparatively simple.

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BEFORE we can start to work on a shaped die at all we must make all of the laps we will need. This is a major job in itself. The bearing laps are usually made with a .010" taper in 3-½" of length and with a ¼" diameter shank 1" long. The cross-sectional contour of the bearing laps are identical with the shape of the hole in the die we wish to make. The small end of the lap is made somewhat smaller than the starting hole size of the die. The number of bearing laps required for completing the bearing of a die would depend, of course, upon the amount of stock to be removed from a die. Usually two to three laps are sufficient except when making from a round hole die. In this case more laps are required.

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IN making all of the shape die laps, we use a small bench shaping machine with a special table attachment and dividing head that with ordinary tool room practices will give us the shape and size we want. In some cases shaped laps may be made from previously drawn stock on which we can, by various means, incorporate the required .010" taper.

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BEARING laps are used in conjunction with a Shape Die Sizing Machine, a piece of equipment that merely makes use of a reciprocating motion in a vertical spindle. The die is placed with the approach angle side up on the work table and the lap is placed in the spindle chuck. Then by adjusting the stroke of the spindle to the correct length, depending upon the size of the die, and using boron

carbide as an abrasive, the lap can be fed down through the bearing of the die increasing the hole size as it moves through. Boron carbide is used as an abrasive to within .012" of finish size, at which time coarse diamond powder is substituted. The coarse powder is used to within .005" of size and from then on, medium grit powder is used.

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THIS operation should be continued until the die bearing is .001" undersize. We will leave the die for a moment now in this discussion and get back to the remaining laps that are necessary to finish the die.

★ ★ ★

WE will need several laps to rough in our approach angle and three or four for the back relief. Here again we use the bench Shaper and setting the dividing head to whatever angle we require for the approach angle and back relief in the die, we merely apply good machining practices and cut down our laps. Both the approach angle and back relief angle laps are used in conjunction with the Die Shaping Machine. Here again is a piece of equipment that applies a vertical reciprocating motion to remove metal from the die. In this case, as the lap held in the spindle chuck is reciprocating, the work table is caused to turn slowly along with the lap and a strong spring pulling the lap always in one direction causes the lap to work on only one area of the die approach or back relief angle at one time. Here again, we use boron carbide as an abrasive. This operation is continued until we have an adequate approach angle and the correct bearing length and from this time up until the die is completed, the work is done entirely by hand. Employing the use of a reciprocating head, shaped laps, wooden dowel laps and fine diamond powder, the approach angle is polished and blended and the bearing is sized and polished. Care must be taken all the way through in making shape dies. It is very easy to create a misalignment between bearing shape and approach angle shape and quite difficult to correct it once it is in the die. Since drawn shaped wire seldom takes the size of the die, the best method of checking is to draw some stock and measure it.

★ ★ ★

Part No. 3
Die Requirements

E. J. Crum

O. K. fellows, we have our making technique down very well. Now let's give some thought to stocking our mill with dies. **George,** what are your ideas along this line?

★ ★ ★

G. Fecsen

IT is very important when stocking a mill with dies that much consideration be given to nib sizes. (By the term **Nib** we refer to the piece of tungsten carbide in the die.) The ideal conditions are that every die purchased be used up through its life and then be thrown away without having a build-up of dies at one or two or three sizes in the wire size range. Obviously we will never attain the ideal since too many of the figures we have to work from are estimates and as such, are too variable. However, we can figure something from the available information that will give us an initial starting point.

★ ★ ★

E. J. Crum

ED DUTHALER, let's have your ideas on determining what nib sizes to stock.

★ ★ ★

E. Duthaler

WELL, first let us refer back to our daily production requirements and somewhat anticipate our requirements in nib sizes.

.015 dia. and smaller	—	5 tons daily
.015 dia. to .040	—	50 tons daily
.040 dia. to .118	—	300 tons daily
.118 and over	—	145 tons daily

★ ★ ★

CHECKING our average die life, we find that dies will be wearing oversize at the following daily rate.

		dies
.015 and smaller	11 x 13 drafts	143
.015 to .040	17 x 6 drafts	102
.040 to .118	30 x 6 drafts	180
.118 and over	Breakdown	30
		455

★ ★ ★

CHECKING our die suppliers' catalog we find that an R-2 can be provided either as a blank or rough cored die with a .004" diameter hole. The maximum recommended hole size for this size die is .128" diameter.

★ ★ ★

AN R-4 nib can be purchased with a .015" cored hole and this size has a maximum hole size of .230". For wire larger than this, we would go to an R-7 which will cover up to .425" dia. The ratio in which these dies should be purchased will be roughly four R-2's to one R-4. So of the 455 dies actually working in the mill, 364 will be R-2's and 91 will be R-4's. For the small amount of wire being produced over .250", we will purchase R-7's as needed. Now this represents the number of dies actually drawing wire in our mill. In following good wire mill practice, we would need enough dies to provide three (3) sets . . .

1. **One set working.**
2. **One set in the finished die rack.**
3. **One set being worked on.**

★ ★ ★

E. J. Crum

THAT seems logical enough. Now **Art,** how should we go about maintaining our stock of dies?

★ ★ ★

Art Hedman

THERE are various ways of doing this, **Jeff.** One of the most widely used is to place dies in the non-durable tool category and maintain a supply between a maximum and minimum number to be determined according to the rate of usage. Although this means quite frequent ordering, it insures against building up too great an inventory and yet there are always dies on hand.

★ ★ ★

E. J. Crum

WALT, suppose you tell us a little about the conditions in which dies can be purchased.

★ ★ ★

W. Schofield

CASED dies are available in any of the three categories:

1. **Rough cored dies.**
2. **Rough drilled dies.**
3. **Finished dies.**

★ ★ ★

THE users of the rough cored dies are mostly those mills that produce a large variety of wire sizes. These people find that they seldom have to open up their dies more than one gage size to have a usable die again. The dies are purchased with the proper cored hole size for their requirements and from then on until the die is thrown away, the jump from one size to the next larger is so slight as to require a negligible amount of rough ripping.

★ ★ ★

THE purchasers of rough drilled dies are usually producing a few specific sizes of wire and the jump from one size to the next larger is so great as to require a long drilling operation. Mills operating in this manner quite often find it economical to purchase their dies rough drilled and then merely size and polish them in their own die room. In doing this it eliminates the need of having a large battery of heavy duty rippers operating continuously.

★ ★ ★

THE mills to whom we supply finished dies are usually the very small volume wire producers who do not maintain their own die rooms. The initial purchase is for finished dies and for reworking, the dies are usually sent back to the supplier or to the small tool and die shops specializing in that type of work.

★ ★ ★

THE small wire mills apparently find this more economical than operating their own die rooms.

★ ★ ★

Part No. 4

Trouble Shooting

E. Miller

THERE are many possible causes of poor die life and poor wire but the die is usually the first to be blamed. In many cases perhaps the die itself is at fault so let's start our trouble shooting from a die standpoint.

★ ★ ★

FIRST the nomenclature of a wire drawing die. Now we'll take the working surface of the die and list the four parts and discuss the functions of each.

★ ★ ★

1. The Bell.

THE bell of a wire drawing die has a relatively unimportant function. It is merely on the die to provide a smooth contour into the approach angle to allow lubricant to reach the working surface. Also, in the case of a breakdown die it allows the wire to enter without scraping the coating off. In some plants the bell of the die is completely ignored with the result that, as mentioned above, the coating is scraped off in spots and the lubricant fails to reach the working surface in sufficient quantity and poor die life is inevitable. An extremely high finish is not necessary; it has merely to be smooth and well blended into the approach.

★ ★ ★

E. Henry

2. The Approach Angle.

THE approach angle of a die is the most important single item in the die. All of the reduction of the wire takes place from the point where the wire strikes the approach angle to the point where the approach and the bearing meet. Obviously this surface has to be smooth and free from scratches. Also important is the included angle and the amount of blend between the approach and the bearing. High carbon steel usually requires a 12° included approach angle with no blend at all while low carbon steel wire dies require 16 to 20° and a slight blend.

★ ★ ★

THE angle of approach may be varied in both cases depending upon the amount of draft. If the percentage of reduction is very small the approach angle should be tightened if the reduction is higher than standard practice the approach angle should be opened up.

★ ★ ★

W. Schofield

3. The Bearing.

THE function of the bearing is to size the wire and control somewhat the type of finish on the wire. The length of bearing for a high carbon steel die should be roughly two-thirds of the diameter and for low carbon steel one-half of the diameter. However, this is not too important. Quite often an excessively long bearing is used on the sizing die to provide a bright finish on the wire. The one important feature in the bearing of a die is the direction of the inevitable taper. An otherwise perfect die can be spoiled merely by having sized it from the wrong end. Let's explain this more in detail. First, please accept this as a fact: **Regardless of the care used in lapping a hole, the end from which it is lapped will always be slightly bell mouthed.** Now apply this to the comparatively short bearings of wire dies and it is readily seen that the bearing will be tapered.

★ ★ ★

LET us compare two dies, one of which has been lapped from the front and the other from the back. Die #1 will show the wire being reduced in diameter all the way from the point on the approach angle where it hits to the extreme back of the bearing. This can cause scratchy wire, and scraping off of coating. On fine wire it will always cause overheating and breakage. It is readily seen that this is a very undesirable condition in a steel wire die. Die #2 on the other hand

(*Please turn to page* 169)

WIRE ASSOCIATION PROCEEDINGS, TECHNICAL DISCUSSIONS OF THE —SYMPOSIUM ON TUNGSTEN CARBIDE DIES—

WEDNESDAY, OCTOBER 19, 1949.

Morning Session—10:00 A. M.

E. J. Crum
General Foreman Wire Drawing
Chairman of Meeting
Bethlehem Steel Corp.
Sparrows Point, Md.

Walter Schofield, Die Service Engineer
Carboloy Co.
Detroit, Mich.

E. A. Henry
Die Engineer
Vascoloy-Ramet Corp.
Chicago, Ill.

E. R. Duthaler
Jones & Laughlin Steel Corp.
Aliquippa, Pa.

E. T. Miller
Sales Eng. Dept.
Firth Sterling Steel & Carbide Corp.
McKeesport, Pa.

George Fecsen
Pittsburgh Steel Corp.
Pittsburgh, Pa.

Art Hedman
Wickwire Spencer Steel Div.,
Colorado Fuel & Iron Corp.
Buffalo, N. Y.

The Technical Meeting of the Wire Association reconvened at ten o'clock, Mr. E. J. Crum, Chairman, presiding.

Mr. A. E. Glen: Before we start this morning's session, there is a point I would like to bring out. We believe we gain more from these meetings through the open discussion we have after the papers are given than in any other way. There is ample time allotted for this discussion and we hope you will all join in the discussion.

Without further ado, I would like to introduce our Chairman for this morning's meeting, Mr. E. J. Crum, General Foreman, Wire Drawing, Bethlehem Steel Corporation, Sparrows Point, Maryland.

Mr. Crum. (Applause)

Chairman Crum: Gentlemen, this morning, we are going to have a panel of experts, and I am not one of the experts. I am just going to be the interlocutor, or "Mr. Bones."

. . . The Symposium on Tungsten Carbide Dies was presented, in conjunction with slides, by the members of the panel.

Chairman Crum: I am sure that you gentlemen will all appreciate what has gone into this paper. I can say this because I didn't have anything to do with it, but it has taken a lot of work to do it.

These gentlemen have tried to tell us how they are doing their job. We realize that a great deal of this is material that most of us know. It is more or less repetitious, but we hope there are a lot of things that might have turned up that will be of some help to you.

It was necessary that we present this as we did in order to give ourselves a start on what we hope will be a free for all question period directed to this board of experts.

Before we start on the questions, I would like to give special attention to the gentleman who did the most for us. All of these men worked on this, but most of all, we give credit to Walter Schofield for writing the script.

Walter, will you take a bow?

Mr. Schofield. (Applause)

Mr. Schofield: I think the rest of the boys put in as much effort as I did, so they really should all take a bow. (Applause)

Chairman Crum: We will now get on with the discussion.

As I said, we have tried to give the methods that are in vogue right now—what we think represents the modern practice throughout this country in producing dies. Of course, there are exceptions here and there and it is the exception that makes the job interesting. So we would like for any of you, who would like, to take exception to anything you have seen or heard here. We want you to get up and speak out.

Who would like to volunteer a question to our board of experts?

A Member: I would like to ask Mr. Schofield, who, I believe, was talking on shaped dies, a question.

He made a statement that they used an Atlas shaper for making lap ends and so forth for shaped dies of all sizes. We have found that under .229 we cannot use a shaper, that is .229 square. I would like to know what range that shaper is supposed to cover and what other methods are used to make bends under .229?

Mr. Schofield: I assume you are talking about standard shapes like hexagons, squares, rectangles and so forth?

A Member: No, I am talking about squares only.

Mr. Schofield: We have gone down as low as a fifteenth of an inch in cross section area, or dimension, rather, and by putting both ends of a lap on center and supporting the middle part by a small jack, you can cut across without having distortion in your lap at all.

If you are trying to make the lap between centers without having support of any kind in the middle of the lap, you are going to get spring spaces over the work.

To show you what I mean, the small end of the taper is supported by the tail stock center of the shaper. The shank diameter is held in the card in that case. That is a three-runged, cross-section piece of steel. You wouldn't need the jack, but now visualize the same lap down around a sixteenth of an inch thick. You would have to have some support under the middle to stop deflection when your tool passes over it, and by putting two or three jacks under it, you can do it.

Does that answer your question?

A Member: No, not entirely. At the end opposite the index head, we have trouble getting the tool down.

Mr. Schofield: I think I see what you mean. In that case, we will take a half a center, so your tool wouldn't be butting into the center itself. You cut the center right directly in half, so your tool is right down to zero point of your lap. It would be level with the center. Does that answer your question?

A Member: Yes, that is better.

A Member: The gentleman second from the right suggested a very highly polished die might not always be necessary. I wonder if he would be willing to amplify on that subject?

Mr. Duthaler: My remarks were that the high sheen that is put on isn't always necessary. The height of the polish in the die is exactly what you feel you require in your own process. Some dies do not need it. For fine wire dies, some say "yes," and they polish down to an eight and nine polish. Have exactly what you deem necessary in your operation.

I have seen dies that have had the most beautiful polish you ever saw being used on a ripper, and after the first bundle has passed through, where is your polish? You have turned your polish—we call them rings—from running around the die and have directed them back straight through the bearing.

Now does that answer it? I know it doesn't answer it, but this question has been asked ever since I came into the Wire Association, and back to 1928.

A Member: I have another question while we are on the subject.

Sometimes you start out with a brand new set of dies and you find your wire scraping, but after the first few coils your scraping will be gone. Why?

Mr. Duthaler: You have polished the die in the direction of the wire and your wire will never go absolutely straight. It revolves itself in passing through that hole. There is a drawing surface that is far superior than what you could put on yourself.

A Member: Do you suggest the wire is twisting as it goes through the die?

Mr. Duthaler: It never holds one true axis, but there is a slight movement back of the wire.

Chairman Crum: I think this is a rather interesting and important point this business of whether we should make a die look like a piece of jewelry or turn it out a little bit more like it is usually done.

Mr. Schofield: I would like to add a little bit to what Ed said on that die.

In polishing any die, your die is revolving. That means you apply the polishing method to it, and all the minute lines caused by it, then, are going to be concentric rings; in other words, you are drawing at right angles to them. After the wire is drawn through it, it causes the lines in the die to be propelled in the direction going through. You are eliminating those small hills and valleys, and, of course,

after the die pulls through a bundle, it actually polishes it, provided it doesn't go oversize in the meantime.

A Member: Also on polishing dies, on using 33 dope, you don't need a polished die. You use carbide and that will give you a good polished finish on your wire.

Chairman Crum: We don't seem to get any objection to that, so I guess it is okay.

A Member: So that we don't have any disappointment about the wire production that is going to be had out of these fine wire dies, particularly when a statement has been made that in some cases a very high polish is not necessary, I would like to have some further comment.

Now in the case of the .016 wire, we have shown an average production of 900 pounds. Now if we are not to give that die a high polish, I would like to have the gentleman at the table say whether 900 pounds of finish wire would be a good average, say, on 006 finish wire, or would they like to change those figures slightly in respect to 006 through 010 wire?

Mr. Henry: In regard to polish, as George said, when you don't have a high polish you have to allow for the die polishing itself by the wire, which will naturally cut close tolerance wire. I believe that is what Walter is talking about, close tolerance.

Now it is my opinion that the higher the polish or the smoother the finish—I don't mean sheen, but just as smooth as possible—the longer that die will retain its size. When you get down in the small ranges of .011 and .016, many times you have only a quarter of a thousandth tolerance, consequently the higher polish you get the longer that die is going to hold its tolerance.

Mr. Duthaler: You notice that I said "sheen." I didn't say anything about finish.

A Member: I think Mr. Hedman could answer that question. I would like Mr. Hedman to make a more definite statement on the production he might get out of an 006 die with a tolerance of, say, plus .2 minus 1. Would you think your figure of 900 pounds would be correct still, Art, or would you prefer to back down on that?

Mr. Hedman: We have another factor entering into the picture here, your drawing speeds. Now, on the old type of machines, which some of us are still using, running at approximately 800 feet per minute and drawing the low carbon wire, we have had productions as high as 6000 pounds per day; whereas with the identical stock in running at a speed of 3600 feet per minute, it immediately cuts it down to about 1000 pounds. Does that answer your question?

A Member: It does, but do you think that you could readily say that you can get an average of 900 pounds per day out of an 006 die running at the high rate of speed that is common practice in many mills today, if you had a tolerance—which is not unusual—of say, plus or minus one-tenth or two-tenths maximum?

Mr. Hedman: Yes, I do.

Mr. Schofield: As to those estimates of die life, we have a range from .006 to .016 diameter on that first group and that is 900 pounds over the range of sizes. That doesn't necessarily mean that we expect to get 900 pounds out of .006 diameter. It might bring it down to 400 pounds. On the other hand .016 diameter might bring it up to 1500. That statement is 900 pounds over the range. If we broke these die lives down per individual die, you would be looking at figures on that board until you were blue in the face. We had to do that to make this thing a little more logical.

A Member: I think that clarifies it. I was only concerned that the customers might expect every die we make to give them 900 pounds.

A Member: Isn't the question of finish concerned with the particle size of a carbide used? We have found on using various competitive dies that certain manufacturers make, using the same diamond powder for finishing, gave apparently, a different finish, rather than competitive dies. I would think that would be a function as to the size of the carbide, for instance, taking a No. 9 diamond carbide that is finer than the carbide particles; is that true?

Chairman Crum: Will you please restate the question?

A Member: Would the size of the carbide particle in the manufacture of the tungsten carbide be more creditable than the finish used on the die, because the finish could not be any higher in degree than the particle size of the tungsten carbide?

We find certain carbide manufacturers furnish dies that polish to a higher degree by using the same diamond dust, and I want to know if a No. 9 diamond powder, for instance, finer than the diamond particle used on the die, polishes to a higher degree?

Mr. Schofield: We don't know the particle size of the tungsten carbide in any grade of carbide. At least, I don't. We are not metallurgists. We are merely, supposedly, die experts. What will give you a higher or less lustrous finish in a piece of carbide will depend more or less upon the amount of cobalt binder holding tungsten products together. If you have a high cobalt content, you will not get as high a finish as if you had a very small cobalt content.

A Member: I wonder if I could add a word to that? I don't believe it is the company that manufactures the carbide that would cause the variation as much as it would be the grade of carbide used.

A Member: In all cases the same carbide was used equivalent to 999 or something of that nature, equivalent carbide metal, carbide 393 and so forth, which are all the same hardness and have essentially the same cobalt condition.

A Member: Conditions being the same, I would say myself the carbide should all take an equivalent polish. There may be a variation in color, but there should not be in the degree of polish.

A Member: On the same basis, certain of these carbides were adequate for finishing fine wire and certain other carbides were not.

Mr. E. T. Miller: I wonder if the implement we are using to polish a die would have something to do with the surface contour as well as the diamond powder or the grain of the carbide. With high magnification I have never seen any hills and valleys with the instruments I have been able to look into. I wonder if the coating we have on our wire when we draw a piece of wire isn't greater than might be on the dies; I mean the thickness of the coating?

A Member: May I offer one other point? We mentioned on Monday here that we found on using diamond dies, even though the die pull was higher than the equivalent die particle on using carbide dies, we could get the ultimate strain of the wire. The question that comes up is whether the carbide particle is of such a magnitude that when you deal with fine wire you have a definite series of edges over which you are drawing the wire compared to a diamond die, which is definitely more homogeneous? As I say, we have found that in using the same method, the same pins, the same diamond dust and so forth, and the same timing and using the same type of carbide of the high type 999 or softer type, as 44A or 779, and other manufactured equivalents, in certain cases the dies gave a very high finish and in other cases they didn't. In certain cases those dies were adequate for drawing fine wire, high carbon, and in other cases they were not.

Chairman Crum: Well now, I think we ought to go into some of the other points, because this is a rather good-sized discussion and we don't want to go past noon time. There are other points, and I would like to get into the question of angles. In our paper here we say that we are going to use a certain angle. Does anybody object to the angle we said that we were going to use?

A Member: There is something that I would like to ask that pertains more to the matter of economy in the wire mill and in the die room.

It has been mentioned here that it is fairly common practice to use a 12 degree approach, or reducing angle, on a tungsten carbide die for drawing high carbon wire. Is that correct? I think that was the statement, and that 16 degrees was a fairly common reducing angle to use on low carbon wire. I know, or at least I believe, a good percentage of the wire mills do have the problem of having both high and low carbon wire running through their mills. Now if a die department should try to keep on hand, or in stock, dies of each of the reducing draft sizes in both 12 degree and 16 degree, I think that they would have a considerable stock or inventory problem in the die room. I would like to hear from the gentlemen as to what they might believe would be a good universal angle, reducing angle, that could be used for both high and low carbon wire, and would enable the die men to pick up any die, and without an excessive amount of work of changing the angle, be able to finish that die to the next larger size? In other words, I would like to hear what they think about a good universal angle for both high and low carbon wire.

Chairman Crum: Well, of course, we have said our piece, but then we want to know whether or not everybody agrees to that. We supposedly agreed

to this thing ahead of time. I see one of our members from overseas, Mr. R. J. Brown, of the Rylands Brothers Company. Will you tell us a little about British practice, Mr. Brown?

Mr. Brown: We haven't made any distinction between drawing high and low carbon steel wire. We use the same dies for high carbon as low carbon, which has been circulated throughout the various mills; and all I can say on that is that after a very prolonged and very careful survey of die pulls that there is no need for any distinction. I cetainly don't agree with the idea of having as large an angle as 16 degrees for our steel. Even for very heavy drafting, we carry our first holes on mild steel at 45 per cent, or a little more. We find angles of ten and twelve degrees, at the very most, give us all the surface we want. I do think, however, the problem is to some extent bound up with this question of length of bearings. We found that the deliberate introduction of a straight taper-bearing to be very considerably useless in general mill practice. We go to great pains to eliminate the bearing altogether. We have the two angles of the die, the drawing angle and the relief angle, put in quite sharply, and we just take the edge off the two angles where they meet, so as to produce the very shortest bearing possible with our heavy draft.

If we do get trouble, and the die comes back, we invariably find we have a little too much bearing on that die. I would suggest that if you look at this question of length of straight taper bearing, you will find that you can simplify considerably the die angle question.

While I am on my feet, Mr. Chairman, I would like to ask whether we are really being well served by the sort of die polishing apparatus that is available to us, at least the commercial machines? The multiple spindle ripping devices have been described today as possessing a combination of reciprocating and rotating mechanism. I think if you will examine the mechanism of that machine, it has no reciprocated processes at all. It is simply rotating the punch the moment it hits the die, and cutting a lot of tram lines round and round the die, which is giving a lot of trouble later on in having to remove them by polishing.

We don't like machines of that type in England, or at least my own company does not. We like the taper punch when we use it, as it is withdrawn to perform a reciprocating function by having a spring load, so that as it is withdrawn it sweeps along the die face and causes a polishing and not just drives home and causes a scoring at the moment of impact.

It is essential, of course, if you do that to rotate the die at the same time as the spindle, rotating it slowly, but I would suggest if methods like that are examined a little more closely it will promote further economy in die room practice and in die room labor.

Mr. A. E. Glen: I would just like to comment on the member's first statement about using a tighter degree in a die angle, of ten or twelve degrees maximum. I believe the tendency in the country over the years here has been to go to smaller nibs. If you carry a ten degree throughout on a heavy draft with the small nibs that are being used in the country today, you would not have sufficient tungsten carbide.

I would say twenty years ago the average operator in this room was using an R-5 die to break down his rods, whereas today they are all practically using an R-3 to break down A-5 rods. As time went on, I don't believe anyone noticed an appreciable drop in die life by widening this angle, so they could use a smaller die nib. I believe the mills will verify the fact by going to the smaller nibs, they have reduced the overall die cost over the years.

A Member: May I ask Mr. Glen whether the nib is being reduced in both dimensions, because we find we can increase the length of nib to advantage and reduce its diameter and still get an economy of carbide. It is the length that counts, not the diameter, providing the length has support.

Mr. Glen: I believe there is some trend in that direction at the moment. I would also like to comment on having no bearing in the die. My experience in this field has been that the bearing might not be too important, but in most of the mills today, they have sufficient bearing to draw good wire and as a ring is formed in the die, they can repolish the die and reduce the bearing length. Now if you did not have any bearing in that die, the first time you polished it, it would go over size and it would seem to me—and I would like to hear something from these men on the board—that it would be recutting a whole lot more dies if they didn't have a bearing in them.

It is our belief that bearing increases your die life, because it will allow you to repolish that die a number of times. I would like to have a comment on that.

Chairman Crum: Has anyone here had any experience with dies without bearings?

A Member: I would like to give my experience. First, I don't believe you could establish a universal angle that would work in every mill. I think the angles have to be determined in the mill itself, but I have had a little theory, or rule, I make in using dies that works very well, and that is to keep the bearing as short as possible and the angle as wide as possible and still maintain control of the wire. By that I mean, especially in high carbon wire, if you get too short a bearing you will have a tendency to have wild wire. In some cases on low carbon if you go a little too small, you will have a hump in the wire.

By following that rule, starting out with the small bearing and increasing it a little, I find it works very well and after a period of time you can establish the standard in your mill and keep it to a minimum. On the high and low carbon wire, it is true that on heavy drafting you can use the same die that you would use on low carbon. It is a wide angle, providing you are using a heavy draft, but in some cases it is necessary to take a very light draft, and then with the wide angle you get a cuppy break, a cone break.

I am not saying that is true in all cases, but you will get it in cases with too wide an angle. I work that out to keep maintaining a combination angle that can be used on both high carbon and low carbon wire, carrying the low carbon to the right angle where the light reduction would hit and the high to where the heavy reduction would hit.

Chairman Crum: Is there anybody in the room from this country who actually uses nibs in the practice of making dies without bearings, and would you like to tell us about it and your experience on it? Here is a man from England who says that we are all crazy.

A Member: I would like to agree with Mr. Brown. I had ten years in a wire mill, which isn't much, but I would like to put myself out on a limb as far as this angle is concerned and say that I think either a 14 degree approach angle or a 16 degree approach angle will give good production as a rule on either high or low carbon wire, keeping in mind what Mr. Glen said about our using smaller nib dies in this country; and it will eliminate a big problem in your die room of trying to stock two separate approach angles in your dies.

Chairman Crum: I am going to hammer away on this question on operators. These die men are all right, but I want to know if there are any operators here who have had any experience in this country in not using bearings?

A Member: It is simply a function. If you have a narrow angle and a longer approach, you have a shorter bearing and vice versa. It is an interchangeable function, and I think as speeds go up, we definitely have to have shorter and shorter bearings in order to obtain the things we want in the wire.

In my opinion, a bearing does not perform any functions as far as finishing your wire is concerned. That is done the minute your contact is made with your bearing, in a few thousandths of an inch. That is all the finish you get on your wire. You are either going to do it or not do it.

I have run dies without bearings, I would say in about a ten-thousandth plane and I have drawn as much wire and better wire than with dies, when I wanted to pull the bearings as long as I wanted to pull them.

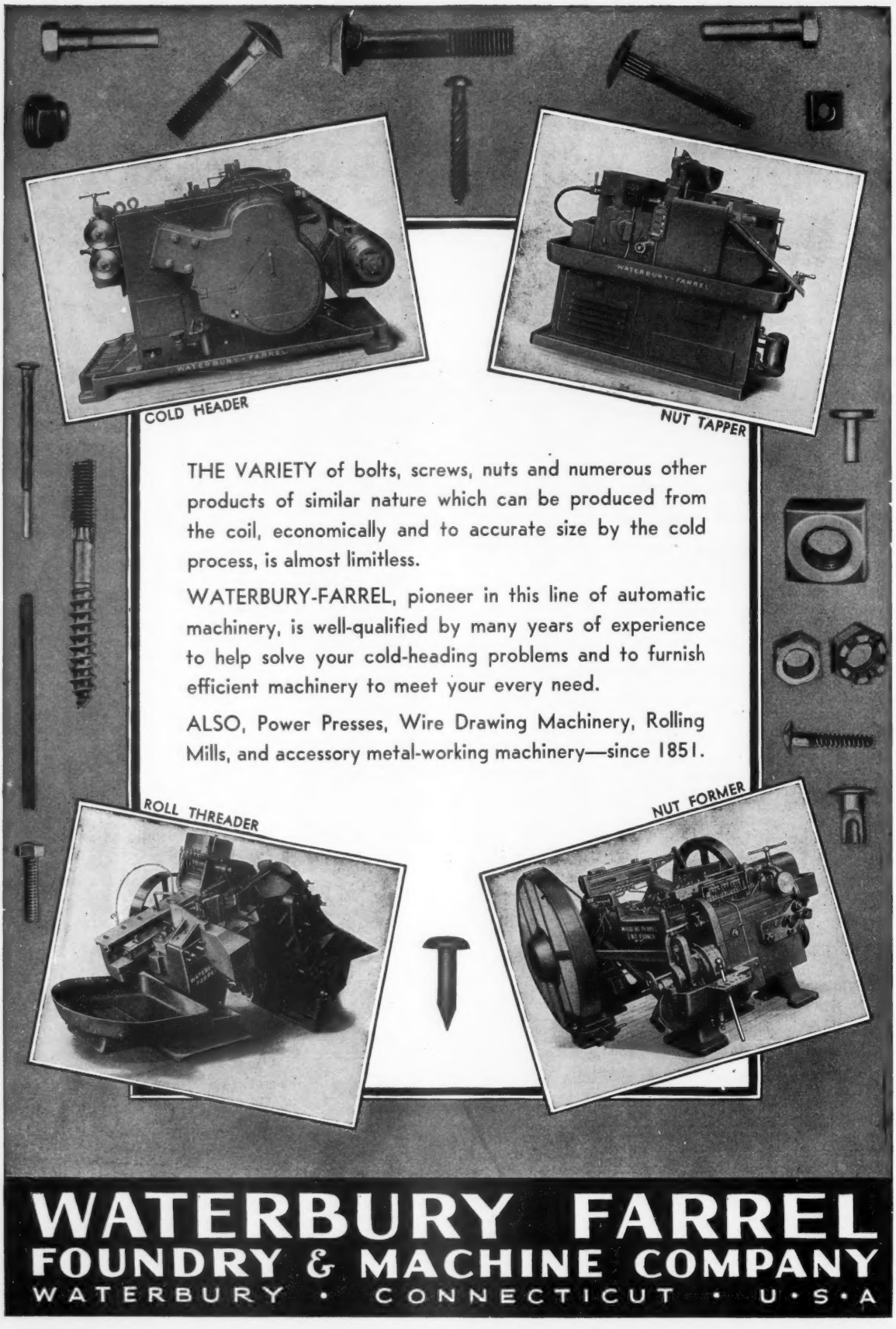
In other words, it is an inter-relation between the length of an approach and the length of draft and bearing, and you can back them up and go from one to the other and have an interchangeable function. I think it is quite a common practice in a number of our plants in this country today to run dies with no bearing at all, all taper.

Chairman Crum: Is all the wire drawn by the men who make dies or the fellows who use dies?

A Member: We have experimented a lot with lengths of bearings and as you know we draw almost entirely high carbon wire up to 300 thousand pounds tensile and in some cases a lot higher, and I have been trying to find out from various men about lengths of bearings, and I asked several of our English friends and they say that the battle is raging in England like it is here.

This morning I talked to one who said they were using long bearings and Brother Brown says no bearings, and so we are working on special cases, and one problem that we are working on is on a size of wire that many of us make, .038 tire bead wire or .037,

(*Please turn to page* 166)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Symposium on the Use and Care of Diamond Wire Drawing Dies

By the Diemakers Committee of Industrial Diamond Association of America, Inc.
John W. Cowan, Chairman
(Panel Members' Names on Page 147)

A paper presented before the Wire Association, introductory to the Diamond Wire Drawing Symposium held under the auspices of the Industrial Diamond Association at the Annual Convention in Chicago, Illinois, October, 1949.

AS a preliminary to a discussion of diamond wire drawing techniques in the interest of economy and efficiency, it is felt advisable to call attention to the necessity for conditioning all suggestions in the following article by a certain important equation; i.e., the difference between diamond and any other product, natural or synthetic, causing diamond specimens to differ widely in quality and shape. Each diamond requires individual study, therefore any prescriptions as to the type and size of the die to be made, of the direction for drilling, and for the wire mill's repair man, must be elastic. The same equations govern the usefulness of the die in spite of the best work of die producer, wire drawer and repair department. To avoid all possible hazards, clear, sound diamonds must be used; diamonds which are in the expensive categories of industrial assortments.

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THE use and care of Diamond Dies in the wire mill, are prime factors in reducing the cost of wire production. The wire mill superintendent who believes his die department is the heart of his wire mill, and his lubrication the blood stream, will have a profitable mill provided he has availed himself of the best in both departments.

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THERE are many other factors, however, that would help to maintain good die life. It is impossible for the die manufacturer to enumerate all of them because of the wide variety of alloys drawn, and different methods employed by the various wire producers.

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IN spite of recent developments, there is still plenty of room for improvement in current practices and many of the wire producers would do well to improve their lubricating and other systems. Much can be done to prolong die life in the mills.

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CAREFUL inspection by the mill foreman at frequent intervals should impress on the wiredrawer the importance of keeping his machines clean, and the lubrication outlets open to allow a constant flow on the die.

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IT is a well-known fact that the wiredrawer hates to part with any die which is still running. The foreman should make a daily check on all dies, the back dies as well as the finishing dies. Any die showing wear should be immediately removed for servicing. On all finishing sizes, there is usually a tolerance of from 1 to 3 tenths of one thousandth inch and the worn die should be removed before the limit is reached, otherwise the mill may find that the wire produced is rejected. In addition, the possibility of loss of production through the increased down time brought on by breaks and rethreading becomes greater with the increase of uneven die wear.

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THE insertion into the set, of dies that are oversize, undersize, or of improper shapes, and having bearings too long for the type of wire to be drawn will cause unnecessary loss by down time. When the die size is enlarged, be it through wear or from any other cause, the percentage of reduction changes.

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HIGH speed, synchronized drawing equipment is built to provide set reductions with a minimum allowance for slip. The usual 5% slip allowance will handle the same amount of die wear. However, it is best to remove dies immediately when they begin to show any wear.

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IF a specific percentage of reduction is used throughout the line of dies without any variation, then the same amount of wire is reduced through the first die as through the last die. So, by the changing of die size or shape, the quantity of wire elongated can be either more or less. This will cause a "pile-up" on the capstan, or else too much stress which will cause the wire to break.

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IN present day drawing, it is, therefore, highly important that dies be removed by sets and rematched for size as well as shape. By doing this the mill will insure itself against excessive, lost down time and obtain the maximum in production.

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WHILE the approximate shapes are advocated, it is recognized that various factors, including the variations of alloys made by the different mills, might properly lead the engineers of the different mills to maintain opinions other than those indicated by these recommendations.

THE correct contours for dies used for different alloys are shown in Figs. 1 to 5, inclusive.

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THIS year, the Industrial Diamond Association offered a prize for original papers by engineers on "Production and Economy Through Industrial Diamonds." The first prize happens to have been won by one of the foremost producers of diamond dies, who also has had a lifetime of experience in their use in England. He is W. F. G. Kerley of Temco, Ltd., Lydbrook, England. We quote from his winning paper by way of an objective effort to allow our hearers to form their own opinions on another long-disputed point . . . "Having formed the opinion that the orientation of crystal structure is not a factor of major importance to die life when diamonds are subject to the usual conditions of commercial reinforced mounting, we can readily see that it would be an advantage to encase the whole, natural crystal before working it and so provide a sound structure unaffected by any weakening of the diamond such as cutting away the natural crystal boundary and also at the same time any harmful effect caused by superficial burning of the die bore in the mounting process. The conserving of the original dimensions by such a process also enables the die maker to make larger initial bores (see the table of carat weight to die bore ratio with stone dimensions) but it is sufficient here to note that we have in suggestion already broken away from our specialization programme. If we adopt the suggested method of fully encasing the whole natural diamond before working it, then we need not consider the grain and cleavage directions or scaife plate work, in fact we take the first step towards the mass production programme."

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FOLLOWING this system of inspection would serve a two-fold purpose, and also cut cost in the long run. First, it would assure more recuts on the die, which would prolong the life of the die

FIG. 1 MONEL & BRASS

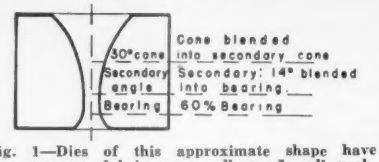

Fig. 1—Dies of this approximate shape have proven successful in many alloys. In all probability, it is the shape generally used in most mills where more than one alloy is drawn, as it is adaptable to general use. This shape is used in various mills for such alloys as brass, commercial bronze, monel, nichrome, nickel, and low carbon steel.

FIG. 2 BRONZE

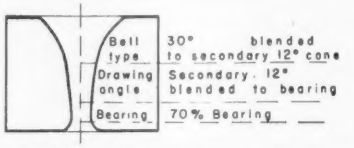

Fig. 2—This approximate shape is found most successful in the drawing of Phosphor bronze.

FIG. 3 COPPER

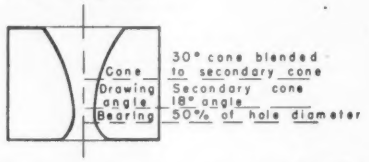

Fig. 3—This approximate shape is primarily for copper, although quite satisfactory on gold, platinum, and silver.

FIG. 4 ALUMINUM

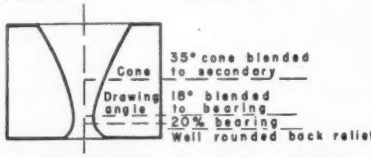

Fig. 4—This approximate shape is suited to aluminum, lead and solder.

FIG. 5 HIGH CARBON STEEL

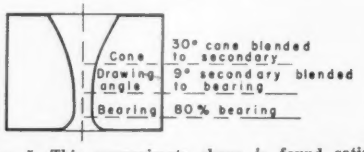

Fig. 5—This approximate shape is found satisfactory on high carbon steel.

and yield greater poundage. Secondly, it would eliminate the difficult task assigned to the die department, of salvaging a burned out die, which had been left too long in the wire machine, or had run on a poor lubrication system, or even without lubrication at all. Any diamond die abused by such treatment may develop a major flaw that will damage some part of the diamond, frequently to the extent of crippling its full usefulness, or cutting the life span of the die in proportion to the extent of the damage. Such a die cannot be recut to the next size.

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THE result of abuse of the die is shown in Figs. 6, 7 and 8. See page 156.

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IN some instances, half of the life of the die may be gone before the die man can put the die in a drawing condition. Even after taking the die up several sizes, a weak spot or fracture still may remain in the stone, which will begin to deteriorate very quickly in the process of drawing wire. At this point, the wire mill must have the best in personnel and equipment, for the wire men expect to have such a die repaired and returned to the mill like a new die. They should be trained to realize how much better it would be for all concerned if some time check for an average running time on the different alloys could be arrived at, before any serious wear could damage and cut the life of the die.

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SUCH a schedule has been established in certain mills and is today showing good results. Since the general conditions have been considerably bettered, these mills are getting more pounds per size, and more recuts out of the dies. Too much importance is stressed in many wire mills on the quantity of dies recut in their die department, rather than on the quality of repair work done. It is to the advantage of the mill to produce a quality die which will stay in the machines without loss of "down time" rather than put in a die that might run only for a few hours, making it necessary to "string up" again, sometimes several times until a die which will run is put in. It would be far better to expend this amount of "time lost" on the dies, and by doing so, cut, rather than increase, the cost of wire production.

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THE recutting of diamond dies, in the majority of wire mills today, is at best a salvage job, and therefore a slow process. Dies to

(*Please turn to page* 156)

THURSDAY, OCTOBER 20, 1949

Afternoon Session—2:30 P. M.

WIRE ASSOCIATION PROCEEDINGS
TECHNICAL DISCUSSIONS OF THE SYMPOSIUM ON DIAMOND DIES

Athos D. Leveridge,
Executive Manager,
Chairman of Meeting

Industrial Diamond
Association of America, Inc.
New York, N. Y.

The Technical Meeting of the Wire Association reconvened at two o'clock, **Mr. Athos D. Leveridge,** Industrial Diamond Association of America, Incorporated, Chairman, presiding.

Preident Seymour: This afternoon we are going to have a Symposium on Diamond Dies, and I am not going to take any more of your time.

I will ask Mr. A. D. Leveridge, who is the Executive Manager of the Industrial Diamond Die Association, to come up and take over on this meeting this afternoon.

Thank you.

Chairman Leveridge: Thank you, Mr. President, and thank you, Gentlemen and Good Afternoon: Mr. William Wind of the Wilbur B. Driver Company, after the paper has been read, will introduce the other gentlemen of the panel.

So, gentlemen, allow me to turn the meeting over to a man who has been foremost, along with his firm for assistance in industry problems in a far-reaching and broad manner through the wartime. It is my personal observation that he has since been helping toward modernization and progress in our industry.

Mr. William Wind. (Applause)

Mr. William Wind (Wilbur B. Driver Company, Newark, New Jersey): First of all I would like to introduce the members of this panel.

Mr. John W. Cowan, Wayne Wire Die Company. (Applause)

Mr. Russell E. Connor, Detroit Wire Die Company. (Applause)

Mr. Fernand Durand, Cochaud Wire Die Company. (Applause)

Mr. Otis Ferrier, Indiana Wire Die Company. (Applause)

Mr. George Stewart, Sylvania Electric Products, Inc. (Applause)

Mr. Albert Richards, Ajax Industrial Supplies. (Applause)

Mr. Pumphrey, Fort Wayne Wire Die Company. (Applause)

It is said that the human brain is a wonderful thing. It starts working the moment we are born and it never stops until we stand up before a crowd to speak.

That is just the way I feel.

What you will get out of this meeting, or from this panel, is entirely up to you. These are all expert die manufacturers, so give them the $64.00 questions.

At this time I will present Mr. Cowan, who has a few remarks before we go into the question period.

Mr. Cowan.

Mr. John W. Cowan: Gentlemen, as Chairman of the Die Committee I have been asked to open our discussion. You have just heard Mr. Leveridge read the committee's paper on the "Use and Care of Diamond Dies in the Wire Mill."

First, I would like to thank the Wire Association on behalf of the Die Committee of the I.D.A., many of whom are or will be Wire Association members, for their invitation to be with you today. Second, we welcome the opportunity of being able to sit down with the men who use our products. I hope when we are all finished we will have helped each other in our mutual problems.

In starting our discussion it might be well for us to review some of the progress made over the past few years. As far back as 15 or 20 years ago, it is common knowledge that a majority of all dies used in the United States were imported from Europe. During that time the Wire Industry has expanded and improved continuously. Today not even 5 per cent of all dies used in this country are of foreign manufacture. We have had to keep pace with you. In the old days a diamond of inferior quality was set in a brass case and held in place with silver solder as its only means of support. These dies were drilled and hand shaped with little or no polish. Today, it is true, we use a smaller diamond but of the highest possible quality. These high quality diamonds, round and semi-round, are mounted in alloys perfected to re-enforce the stone so that it will withstand the constant pressure and friction developed in high speed drawing. These present day pre-selected diamonds reenforced in newer mountings, mechanically shaped to conform to any specifications and with the highest polish ever attained, are responsible for your success in your high speed machines, drawing quality wire and for the remarkable poundage of today.

In conclusion, we would like to raise this question: "Is it economical for the wire producer to run dies in the 'string up' after they have been recut three or more times, especially in the intermediate and larger sizes?"

My contention is that it is poor drawing practice. The diamond is burned to the deterioration stage and if used further gives trouble and only increases cost through "down time" and labor expended in the effort of salvage.

Mr. Wind: Is there anybody out there who would like to answer that question?

A Member: What are the special alloys you use for mounting? I have representatives from the diamond die firms call on me and in the last few years we have tried several different alloys. I don't believe that you have that alloy developed. If you have, why not tell the boys?

Mr. Cowan: We all have our own ways of mounting stones today, and for us to divulge what we have actually taken years to develop is something we don't want to do just now.

Mr. Wind: Perhaps you don't, John, but maybe someone else on the panel wants to tell.

I guess not. Maybe they have their own secrets.

Would anybody like to answer this question?

Is it economical for the wire producer to run dies in a string-up, after they have been recut three or more times?

A Member: I don't believe it is.

Mr. Wind: Can you tell us why?

A Member: I believe after you have run a die three or more times and from what the slide shows of the wear and tear, plus sizes of the diamonds in use and averaging the runs of the metal in pounds, I sincerely believe it is best not to try to recut too many times; that it is cheaper to get as much from the diamond on the first few runs for low cost and a high level of efficiency and quality wire. I sincerely believe it doesn't pay to run a die three or more times.

Mr. Leveridge: In that the question was raised by the Committee Chairman, Mr. Cowan, it must have been based on the fact that wire mills are doing just that thing. Now if they are doing it, they must disagree with him. The wire specialists are here, so why don't they take issue with the statement or stop running dies in the manner he criticizes; one or the other?

Wouldn't there be someone here who would like to show that Mr. Cowan's point is **not** sound?

Mr. Wind: I guess they are all keeping to their own ideas or not recutting them after two or three times.

Mr. Leveridge: Or they are blushing. Our purpose, Mr. Chairman, is to help get the best service out of the dies. Evidently the mills are not doing that, or Mr. Cowan wouldn't have raised the point.

Mr. Cowan: I don't think they are doing that intentionally. I think they are over-running the die in the first two sizes, and spending a lot of labor on the die of the third and fourth sizes to put them back in shape, and in doing so it is very costly, only they don't realize it. If they did, they would watch the dies more in the first two or three sizes and get more recuts.

Mr. Wind: Don't you think that you want to accentuate that now.

Mr. Cowan: That is exactly what I mean.

Mr. Wind: Perhaps some of the boys are getting so many recuts on the dies, they don't want to give us an inkling as to how far they do recut the dies.

Gentlemen, have you any other questions you want to ask this panel?

A Member: I wonder if the statement shouldn't say something about material to be drawn. We are in the copper business altogether, and some of our diamond die suppliers are in the panel. We buy our dies to a specification, which says in many sizes they are to be able to recut six sizes and these fellows all sell them to us.
(Applause)

(*Please turn to page* 159)

Outstanding Personalities of the Wire Industry

J. Edward Donnellan Vice-President, "Wire & Wire Products"

J. EDWARD DONNELLAN who joined the staff of **WIRE & WIRE PRODUCTS** on March 1st, 1948, became vice-president of the company effective January 1st, 1950.

★ ★ ★

MR. DONNELLAN brought a wealth of ability and experience to our organization that will enable us to increase our many services to the wire industry. He has been perhaps best known for the twenty years of work in the metal field with the American Society for Metals, whose staff he joined in 1924.

★ ★ ★

HE played an active part in the staging of the National Metal Exposition and was for many years the editor of the Metals Handbook. In 1944 he became vice-president in charge of sales for the General Alloys Company of Boston.

J. Edward Donnellan

★ ★ ★

SINCE his graduation from Pratt Institute in Brooklyn as an industrial chemical engineer, he has been directly associated with the metal industry continuously, having been with the New Departure Manufacturing Company and the Holcomb Steel Company before his identification with the Society.

★ ★ ★

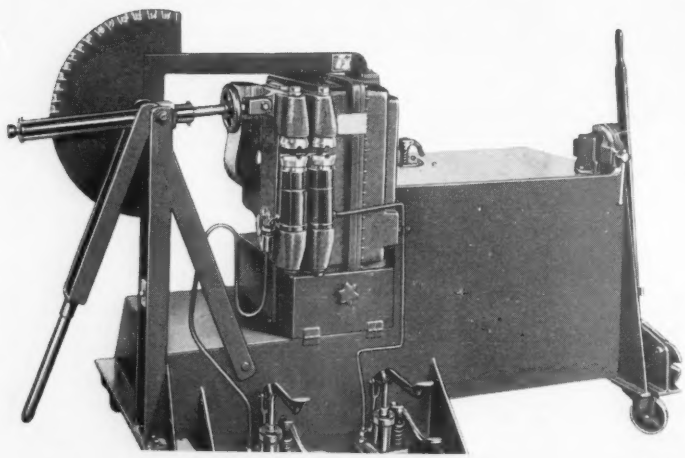
Sharon Steel Advances Roemer

HENRY J. ROEMER, JR. was recently made vice-president and general manager of the **Sharon Steel Corporation,** Sharon, Pa. He had been vice-president in charge of raw materials, purchasing and traffic.

★ ★ ★

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

MODEL L-3 MICRO-WELD BUTT WELDER



This type welder is available in three Models (L-1) (L-2) (L-3) for welding COPPER Rods and other non-ferrous metals ranging in size from 5/16" to 7/8" diameter.

The illustration shows the Model L-3 MICRO-WELD Butt welder, equipped with foot operated hydraulic clamping mechanism, radius grooved welding dies and die shoes, and with a single control lever for the spacing operation, and contacting the welding switch.

Welders can be furnished on stationary base, or mounted on 4-wheel truck.

MICRO PRODUCTS COMPANY

20 NORTH WACKER DRIVE
CHICAGO 6, ILL.
Telephone: STATE 2-7468

New Positions for Roebling Men

E. A. TRASK, former head of the San Francisco office of **John A. Roebling's Sons Company** of California, assumed his new duties as manager of sales of the company's Chicago corporation on January 1. **G. C. Bukowsky,** former manager of the Portland, Oregon branch, succeeded Mr. Trask. The appointments were announced by E. C. Low, vice president in charge of sales of the parent organization, Trenton, N. J. manufacturers of wire rope and related products.

★ ★ ★

MR. TRASK joined the Roebling organization twenty-five years ago, starting as a warehouseman and splicer. He became a salesman in 1931 and nine years later was made manager of the San Francisco branch.

★ ★ ★

MR. BUKOWSKY, a graduate of the University of Oregon, has also been associated with the Roebling Company since 1925, starting as a salesman in the logging and mining territories of Idaho, Oregon and Southern Washington. He was elevated to the managerial post at Portland in 1942, and has served in that capacity until his recent transfer.

★ ★ ★

Old Diamond Die Companies Merge

AS of January 1, 1950 the American Branch of the **Vianney Wire Die Company** of New York City, which has been operated by **Victor J. Boulin,** was merged with **Balloffet Dies and Nozzle Co., Inc.,** 6825 Adams St., Guttenberg, New Jersey, and operates from this address as the **Balloffet-Vianney Wire Die Co., Inc.**

★ ★ ★

THE new corporation will operate under the management of **L. Chambre,** Executive Vice-President and Treasurer, and will continue to serve the wire industry with the highest quality diamond dies, for which these two concerns have been noted. Balloffet has been making dies since 1870.

★ ★ ★

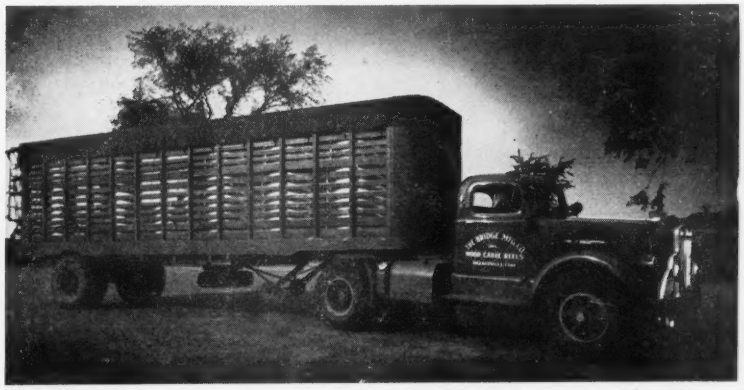
WOOD REELS
with SERVICE plus

If your mill is located anywhere within 200 miles of Hazardville, we will deliver them to your door in BRIDGE trucks—and overnight, in case of emergency.

For points beyond, carload shipments out of Springfield, Mass., via N.Y.C.R.R. can be in cities as far away as St. Louis on the third day. L.C.L. shipments to points like Buffalo or Cleveland via the Pacemaker will arrive the second morning and be delivered to your door *at no extra cost.*

BRIDGE REELS for CABLE, ROPE and WIRE are made in returnable and non-returnable types in sizes from 12" to 96" in diameter.

ALSO, REELS, HEADS FOR STEEL DRUMS BRIDGE SHIPPING and SHOP REELS are furnished assembled or knocked-down, made to your specifications. Built to withstand severest handling.



You are invited to avail yourself of our unique and efficient service and to visit our plant to see how BRIDGE REELS are made so well and why they are so sturdy and low in cost.

Send us your specifications and let us quote on costs.

BRIDGE MFG. CO.
Inc.
HAZARDVILLE • CONNECTICUT

JOHNSON is a wire specialty plant, not a tonnage mill. Every Johnson wire is drawn under close laboratory supervision, resulting in the specific wire for its intended use. Whether it be Music Wire — "The wire of a thousand uses" — or wire that is to be devoted to the enhancement of the lady beautiful (bobby pin wire, brassiere wire, or corset stay wire), Johnson goes in for top quality and ease in processing. For example, Johnson Stainless Steel (18-8 grade, types 302 and 304) comes to you with lasting harmless lubrication (not to be removed).

Whatever your requirements in high tensile wire, let Johnson specialists go to work for you. You will find that the time saved in processing, less down-time, and the reliability of your production will be well worth while.

JOHNSON
STEEL AND WIRE CO., INC.
WORCESTER 1, MASS.

NEW YORK PHILADELPHIA CLEVELAND DETROIT AKRON CHICAGO
ATLANTA HOUSTON TULSA LOS ANGELES TORONTO

Joins Standard Varnish Works

CARL BAUER, Industrial Sales Manager of **Standard Varnish Works,** New York, announces the appointment of **Hugh C. Crawford** to the position of Industrial Sales Promotion Manager.

★ ★ ★

MR. CRAWFORD has been active in the industrial finishes industry for many years and has held several important positions in sales and official management.

★ ★ ★

HIS efforts will be directed toward enlarging the sales of Standard's well recognized line of general industrial finishes.

★ ★ ★

J. R. Hill to Head Northwestern's Sales Department

J. R. HILL has been appointed General Sales Manager of the **Northwestern Steel and Wire Company,** Sterling, Illinois. He has been with the Company for seventeen years. **R. J. Kay** and **G. W. Bulmer** have been made Assistant Sales Managers.

★ ★ ★

MR. HILL'S appointment was made to fill a vacancy caused by the resignation of **A. B. Sloan** as Vice President in charge of Sales, a post he has occupied since 1928. Mr. Sloan will hereafter divide his time between his personal interests and the company, which he will continue to represent on a part-time basis.

★ ★ ★

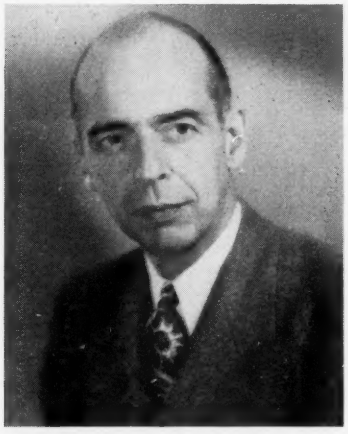
F. B. Foley Joins Inco Staff

FRANCIS B. FOLEY, formerly of The Midvale Company, Philadelphia, has joined the staff of the Research Laboratory of **The International Nickel Company, Inc.** at Bayonne, N. J. as Consulting Metallurgist, N. B. Pilling, Director of the Laboratory announces. A collaborator with the late Henry M. Howe after World War I, Mr. Foley joined Midvale in 1926 in a research capacity and later became Chief Research Engineer.

★ ★ ★

J. M. Wilke Advanced by Laclede Steel

J. M. WILKE has been appointed General Manager of Sales by the **Laclede Steel Company,** St. Louis, Missouri, succeeding **Walter W. Arpe,** who has retired. Mr. Wilke's place has been taken by **Harold R. Kilpatrick,** who now is Manager of Wire Sales.



J. M. Wilke, General Manager of Sales, Laclede Steel Company, St. Louis, Mo. * * * *

MR. WILKE started with Laclede in 1906 in the Operating Department at Laclede's mill in Madison, Ill. After serving in the Chicago District office for several years, he was sent to Detroit in 1925 as District Sales Manager. In 1945 he was transferred to the home office.

★ ★ ★

MR. ARPE has had a long and interesting career in the Steel industry, beginning with his joining the old Western Tube Company in 1901. In 1924 he became associated with Laclede and in 1946 was appointed to the office from which he has just resigned.

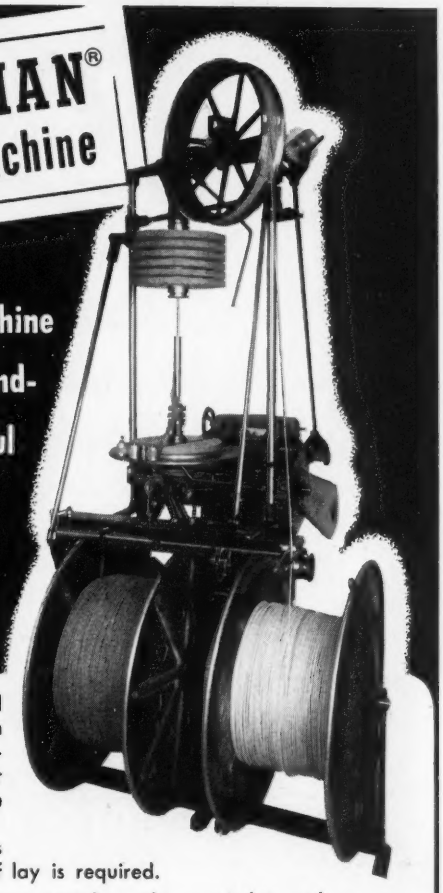
★ ★ ★

H-VW-M Advances Chemists

THE HANSON-VAN WINKLE-MUNNING CO., Matawan, N. J., announces the advancement of two members of its Laboratory staff, **Dr. D. Gardner Foulke** and **Thomas J. Menzel,** the first now being Chief Chemist in charge of analysis and customer service and the latter becoming their Plating Chemist.

★ ★ ★

WARDWELLIAN®
Tape Serving Machine



A Special Wardwell Machine With a Long and Outstanding Record of Successful Performance!

Applies Narrow Width Tapes (up to 1" wide) To Electrical Conductors.

Has electric stop-motion and capstan-release mechanism which permits the conductor to be retracted and placed in position for re-run after supply has been replenished.

"Reeves" variable speed unit gives quick adjustment when change of lay is required.

Adjustable traverse mechanism lays material evenly on windup reel.

Other Features Include These:

- Machine will produce 58 feet per minute giving a maximum lay of 1". Minimum lay is 3/8".
- Serving head speed 700 R.P.M.
- Driving pulley 8" diameter; 1¾" belt. Speed 330 R.P.M.
- Ratio serving head speed to pulley speed 2.12 to 1.
- Capstan 18" diameter, 3" face.
- Opening through serving head 3/8" diameter.
- Maximum diameter of flexible conductor 3/8".
- Supply packages 12" diameter, 1" maximum width, 3/8" minimum width. Size of hole in package 3"
- Supply tube will hold 6 packages, 1" wide, sufficient for normal lengths of conductors.
- Maximum power requirement ½ H.P. including power transmission.
- Motor drive furnished upon request.
- Stands can be furnished to take reels as follows:
  30" diameter and up to 13" outside width
  30" diameter and up to 16" outside width
- Special wind-up driving parts required for reels with drums under 8" diameter.
- Reels are not included with machine.

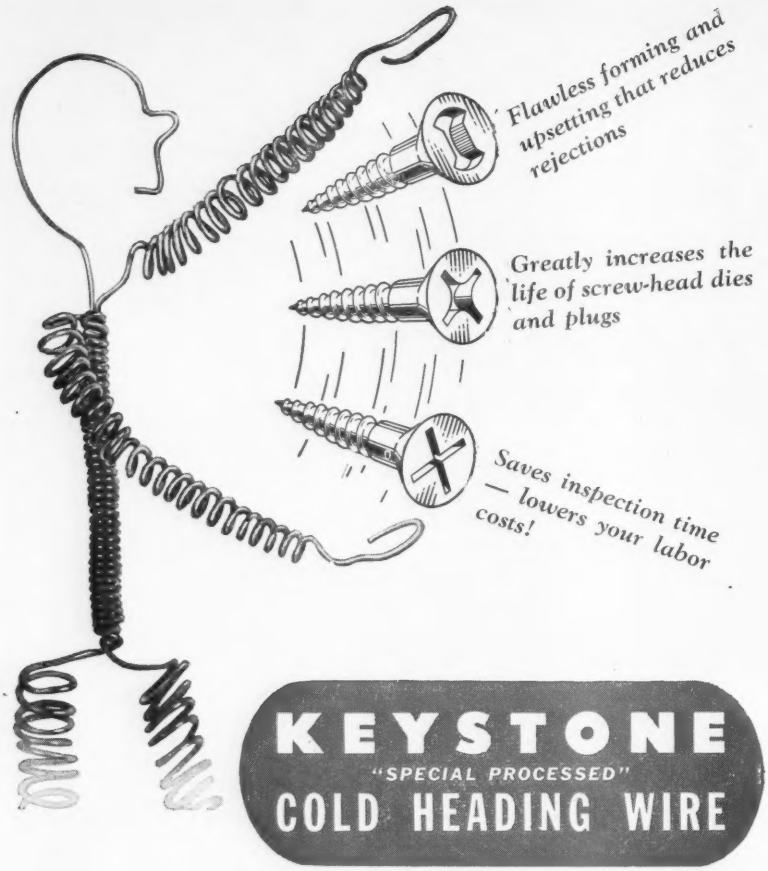
NOTE: Serving Head normally runs clockwise, but can be made to run counter clockwise upon request.

Complete detailed information on "Wardwellian" Tape Serving Machine on request.

There are nearly thirty applications for Wardwell equipment, including Braiding, Shielding with wire, Tape Serving, Yarn Serving, Asbestos Serving, Paper Serving, Armor Serving and Resistance Wire Serving.

WARDWELL
BRAIDING MACHINE CO.
Central Falls Rhode Island, U.S.A.

Representatives for Europe, British Colonies and Dependencies
JAMES MACKIE & SONS, LTD., BELFAST, IRELAND


Flawless forming and upsetting that reduces rejections
Greatly increases the life of screw-head dies and plugs
Saves inspection time — lowers your labor costs!
KEYSTONE
"SPECIAL PROCESSED"
COLD HEADING WIRE

For recessed heads, Keystone's new special-process wire delivers the desired upsetting and die forming qualities with such a high degree of uniformity that finished product rejections are practically eliminated . . . individual inspection of screws is no longer necessary . . . die and plug life are often more than doubled. This new wire effects considerable savings in the production of Phillips head, clutch head and cross recessed head screws.

Keystone is prepared to help solve any of your industrial wire problems. If special treatment is called for, Keystone's metallurgical research and testing facilities are available to supply the answers. We welcome your inquiry.

KEYSTONE
STEEL & WIRE CO.
PEORIA . . . ILLINOIS

Special Analysis Wire, Setting New Standards of Performance

J. K. Beeson Made President of Pittsburgh Gage and Supply Company

J. K. BEESON, executive vice president of the **Pittsburgh Steel Company** will resign in April to assume his new duties as president of the **Pittsburgh Gage and Supply Company.** He has been a director of the company, which was founded in 1892, since 1941. Mr. Beeson is the fourth president the company has had, the second having been his father, the late Charles E. Beeson. Mr. Beeson is a past president of the Wire Association.

★ ★ ★

Changes Company Name

THE WILLIAM M. PARKIN CO., Highland Building, Pittsburgh 6, Pa., changed its name as of January 1, 1950, to **THE PARKIN CHEMICAL COMPANY.**

★ ★ ★

THERE are no changes in personnel contemplated, the new name having been decided upon to more clearly reflect the nature of the business—that of supplying acid inhibitors and pickling compounds to industry.

★ ★ ★

Reynolds Metals Adds to Production Staff

EDGAR T. LONG has joined **Reynolds Metals Company** as assistant product manager of the Wire, Rod, Bar, and Rolled Shapes Division, according to **David P. Reynolds,** vice president and manager General Sales Division of the company at Louisville, Ky. Mr. Long will be located at 2500 South Third Street, Louisville.

★ ★ ★

BORN in 1899, Mr. Long was educated at Eufala, Ala., High School and Riverside Military College. Soon after finishing school in 1920, he was employed by Gulf States Steel Company, Birmingham, Ala., as manager of wire sales; later he became special representative of that company at Nashville, Tenn.

★ ★ ★

IN 1938, he went with Bethlehem Steel Company and served as sales representative for that company on all its products for Southern Indiana, Southern Illinois, and West Kentucky areas. He also was manager of Bethlehem's warehouse at Evansville, Ind.; and later was put in charge of Wire Goods and Road Dowel Mills at Bethlehem's Johnston Steel Plant, Gautier Division.

★ ★ ★

Establishes Own Die Manufacturing Company

WITH the sale of the Vianney Wire Die Works, American branch of Etablissements Joseph Vianney, to another concern, **Victor J. Boulin,** its American representative for the past 37 years, is opening his own office at the same address, 250 East 43rd St., New York, N. Y. Mr. Boulin will continue with the sale of first quality diamond and carbide and diamond powders. A repair service will be maintained.

★ ★ ★

Frank Nichols Phillips

FRANK NICHOLS PHILLIPS, president of the **Washburn Wire Company** in East Providence died on December 9th. He was 75 years old.

★ ★ ★

MR. Phillips was a director of Phillips Electrical Works, Ltd.; the Ryan Aeronautical Company of California, the Industrial Trust Company in Providence, the Associated Springs Corporation of Bristol, Conn., and the Providence Building Company.

★ ★ ★

MR. Phillips' father, the late Eugene F. Phillips, started the American Electrical Works here about 1868 for the manufacturing of copper wire. In 1900 the Washburn Wire Company was formed to make steel wire in a section of East Providence that since has been known as Phillipsdale.

★ ★ ★

THE son entered the business after his graduation from Massachusetts Institute of Technology.

Announcing...

A Complete Line
of
Spray, Dip and Brush
PHOSPHATE COATING CHEMICALS
for
PAINT-BONDING
RUST PROOFING
and DRAWING

Paint-Bonding **"Granodine"** — zinc phosphate coating chemicals, applied by spraying, dipping, or brushing in a cold, medium, or hot process, improve paint adhesion on steel, iron, and zinc.

"Lithoform" — zinc phosphate coating chemical, applied by spraying, dipping, or brushing at room temperature, makes paint stick to galvanized iron, zinc and cadmium.

Rust Proofing **"Permadine"** — zinc phosphate coating chemical, applied in an immersion process forms an oil-absorptive coating on iron and steel that bonds rust-inhibiting oils such as **"Granoleum."**

"Thermoil-Granodine" — manganese phosphate coating chemical, applied in an immersion process, forms a dense crystalline coating on iron and steel which, when oiled or painted inhibits corrosion and when oiled protects friction surfaces.

Drawing **"Granodraw"** — zinc phosphate coating chemical, used in an immersion process, facilitates the mechanical deformation of steel.

Write for further information on any of these phosphate coating chemicals and processes and how they can be adapted to your production.

Pioneering Research and Development Since 1914

AMERICAN CHEMICAL PAINT COMPANY

AMBLER, PA.

Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

A Review of Recent Wire Patents

NO. 2,490,206, METHOD OF NORMALIZING COILED SPRINGS BY A HIGH-FREQUENCY MAGNETIC FIELD, patented December 6, 1949 by Joseph L. Calley, Detroit, Mich., assignor to The Murray Corporation of America, Detroit, Mich., a corporation of Delaware.

The method of normalizing coiled springs made of magnetic material and having at least one coil forming a completed loop includes the step of advancing a number of the springs simultaneously through a high frequency magnetic field, and rotating them as they are passed through the field with the axes about which the springs are coiled disposed perpendicular to the path of the magnetic field.

★ ★ ★

NO. 2,490,264, RUST PREVENTING COMPOSITION, patented December 6, 1949 by John D. Garber, Cranford, N. J., assignor to Standard Oil Development Company, a corporation of Delaware.

The composition consists of 80 to 98 parts of mineral oil, 0.1 to 10 parts of an oil soluble petroleum metal sulfonate, and 0.5 to 15 parts of a copolymer of butadiene and diisobutylene, having a molecular weight between 3,000 and 5,000.

★ ★ ★

NO. 2,491,293, CORELESS OPERATING CABLE, patented December 13, 1949 by Charles M. Zerr, Independence, Mo., assignor to Union Wire Rope Corporation, Kansas City, Mo., a corporation of Missouri.

In this cable there is provided a number of wire ropes bound together to form a composite elongated unit, these ropes being stranded about the longitudinal axis of the unit, this axis being coreless.

★ ★ ★

NO. 2,491,301, SAFETY PIN, patented December 13, 1949 by Dan Leo Dodds, Texas City, Tex.

This pin is formed of a single length of wire with one end portion bent into a stirrup-like portion to retain the opposite (pointed) end portion of the length of wire.

★ ★ ★

NO. 2,491,309, HAT CREASE SHAPE HOLDER, patented December 13, 1949 by Henry H. Hanson, Tyler, Tex.

Complete Description and Drawings of Patents May Be Had for 50 cents, outside the United States and Canada $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

The holder is formed wholly of bent wire, portions thereof being adjustable.

★ ★ ★

NO. 2,491,782, APPARATUS FOR STRAIGHTENING STRIP MATERIAL, patented December 20, 1949 by Howard H. Talbot, Pittsburgh, Pa., assignor to United Engineering & Foundry Company, Pittsburgh, Pa., a corporation of Pennsylvania.

More specifically, the apparatus is for cold working strip metal and means is provided for preventing defection of the straightening rolls.

★ ★ ★

NO. 2,492,221, COMBINED WIRE AND RIBBON GRINDER, patented December 27, 1949 by Louis Illmer, Cortland, N. Y.

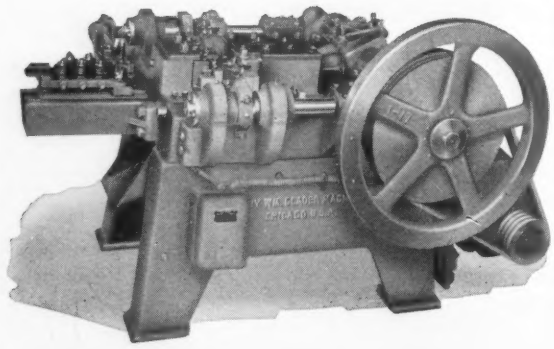
This strand grinder is provided with a tubular grinder through which the angle active work piece is conveyed.

★ ★ ★

NO. 2,492,352, CABLE ADAPTED TO FORM THE METAL CARCASSES OF PNEUMATIC TIRES, patented December 27, 1949 by Pierre Marcel Bourdon, Paris, France, assignor to Manufacture de Caoutchouc Michelin (Puiseux, Boulanger et Cie), Clermont-Ferrand, France.

(*Please turn to page* 165)

GLADER HIGH SPEED WIRE NAIL MACHINE



MACHINE ARRANGED FOR INDIVIDUAL MOTOR DRIVE

High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS
210 No. Racine Ave.
Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

On to Peoria . . . in May

There will be a

MIDWEST REGIONAL MEETING

of the

WIRE ASSOCIATION

at the Pere Marquette Hotel, Peoria, Ill., May 11 and 12, 1950

Peoria has been selected for this meeting by your directors due to the fact that the Annual Convention will meet in the East, in Baltimore, in October this year.

A top-notch program of interest and value to wire men is being arranged by the Program Committee, under the chairmanship of John A. Moritz, Superintendent of the Wire Mills of the Keystone Steel and Wire Company of Peoria.

It will be a two-day session with technical papers and a plant visit through the Keystone mills.

Make your plans now so that you can be in Peoria for these two important days. Details of the program will be announced next month.

THE WIRE ASSOCIATION

RICHARD E. BROWN, Executive Secretary

300 MAIN STREET — STAMFORD, CONN.

Hydraulically Operated **TRAVERSE REELS**

FOR FLAT WIRE AND NARROW STRIP

• The self-contained, compact SECO Traverse Reel has smooth, powerful hydraulic operation — at speeds from 150 to 600 feet per minute.

PERFECT SPEED CONTROL from zero to top running speed through flow control.

ACCURATE TENSION CONTROL through pressure regulation.

Built in sizes for coils weighing up to 600 lbs., for round or flat wire. Unit shown occupies floor space 24" x 42". Modifications in design and construction to meet specific requirements.

WIRE SPOOLERS

Single and Multiple Type

Speeds Up To 4,000 feet per minute

STEEL EQUIPMENT CO.

SECO 2890 EAST 83rd STREET
CLEVELAND 4, OHIO

Symposium on the Use & Care of Diamond Wire Drawing Dies

(*Continued from page* 146)

be recut generally have to be run on the polishing machine a short time before the die man can determine the size they can be recut to. In many cases, it takes days to clean up a die before all of the fractured and burned up parts of the diamond are lapped to a clean drawing surface again. This operation has to be performed with fine diamond dust.

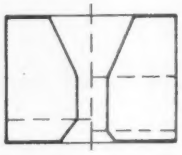
★ ★ ★

IN nearly every wire mill, when something goes wrong, the first conclusion drawn is that it is the dies which are at fault. The wire men know as well as the diemakers, that if conditions from the casting shop to the finished wire are perfect, the dies will function perfectly, too.

★ ★ ★

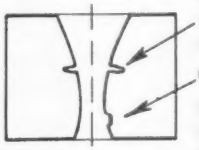
EXAMPLES OF NEGLECT OR POOR SHOP PRACTICES

FIG. 6 A POOR DIE.



Sharp front; too long; highsided back. This die will cause sucking and continual breaks. If it runs, will break out in back.

FIG. 7 RING DEVELOPED IN FRONT AND BACK DURING WIRE DRAWING.

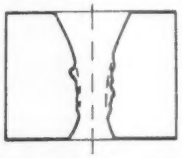


This wear shows die having been left in machines too long.

Piece chipped out.

Either defect will require reshaping both back and front before further service can be obtained, short die life indicated.

FIG. 8 POOR LUBRICATION AND DIE HAVING BEEN LEFT IN MACHINE TOO LONG



The life of this die has been halved even in the first draw

This can occur on one or both sides.

Results of Abuse of the Die Shown Above ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

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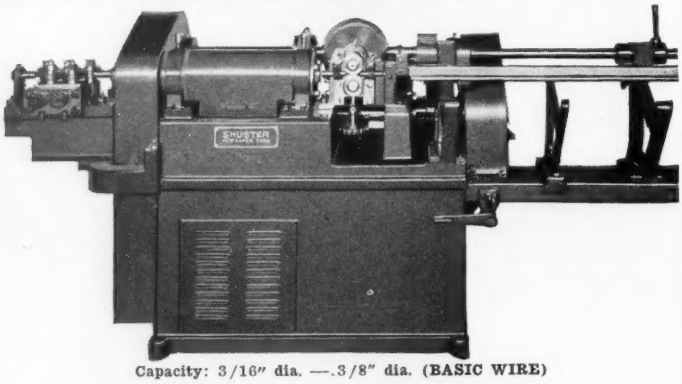

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THERE are many factors that contribute to short die life, such as inclusions in the rod, poor pickling, no uniformity in the annealing, too many alloys running off the same lubrication system, variations in the lubrication mixture, rough capstans, too much or not enough slip, and from a diemaker's viewpoint, running carbides and diamonds in the same series. One or the other may be run but never both together, as the diamond will be certain to break before reaching its normal wear point. The carbide die will wear oversize faster than the diamond die, and so put additional strain on the diamond, causing it to break.

★ ★ ★

THE wire mill which can afford a good inventory of dies, can in the long run, get greater value for its money than the small mill, or the one which buys dies only when there is an immediate need. A die department with a good stock can remove the whole set and replace it with a matched shape set.

★ ★ ★

THE shaping and polishing of the die are the two most important operations of the die. Both must be as near perfect as is possible, to get the maximum poundage. However, the best made die, designed for any particular alloy, can wear or break out long before its time, if it does not get the proper lubrication or if the wire is full of inclusions. The other factors mentioned previously must be checked to prevent die destruction. In many of the wire mills that are drawing several alloys, it is a common practice to put any die in the string up. This is done in most cases where there is an insufficient stock of dies and these wire mills are increasing the cost of their wire production by doing so.

★ ★ ★

THE shape and polish are so important that some uniformity should be adopted for the various alloys, and in particular for the individual mill. Only after "time runs" can the best shape for the individual alloy and mill be arrived at. After this optimum shape has been ascertained, it is imperative that the die department adhere to their findings.

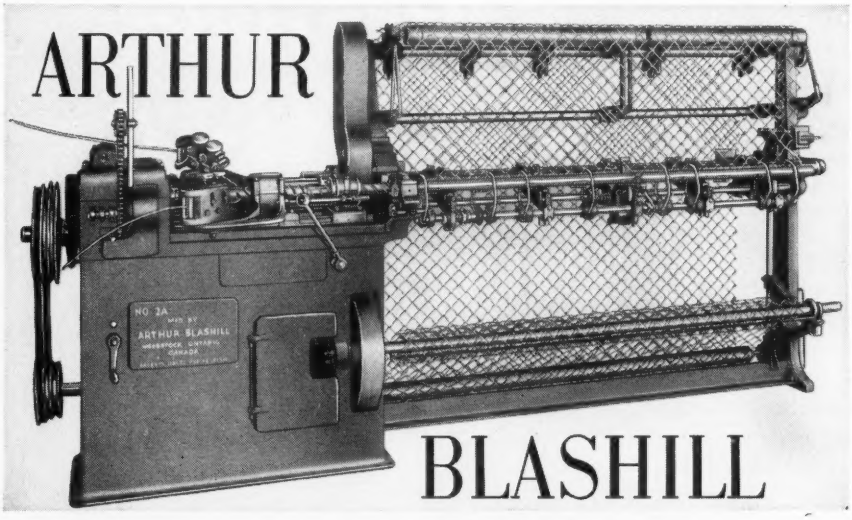
★ ★ ★

IN conclusion, the die manufacturers are as a whole producing today a far superior product to any previously produced in the history of the industry. The dies now are produced by men with years of experience. Their experience, combined with new methods and equipment developed during the war, is increasing profits for the wire producers. In spite of general increases, dies have not gone up in proportion over 25%, and in many cases not even that.

★ ★ ★

IF the many faults in the wire mills were carefully corrected, it would become a demonstrated fact that the wire manufacturer would attain greater production at a much lower cost.

★ ★ ★



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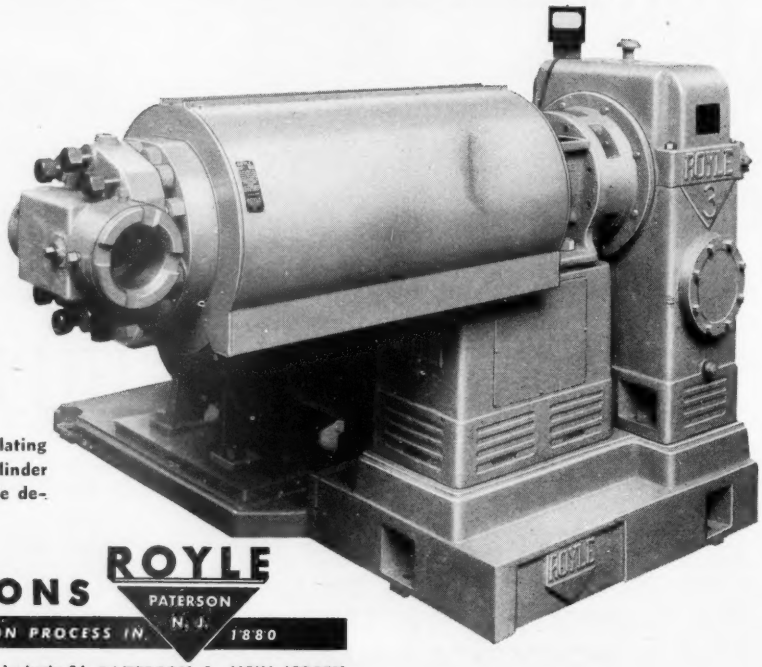

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PATERSON 3, NEW JERSEY

Wire Association Proceedings Technical Sessions Discussions on the Diamond Die Symposium

(*Continued from page* 147)

Mr. Cowan: Might I answer that in this way: You, I believe, are drawing 10,000 feet per minute.

A Member: No, sir, that is the wrong Western Electric plant. No, we are speed artists, but 5,000 is as high as we go.

Mr. Cowan: Isn't it possible that you are at fault? Perhaps you leave the dies in too long.

A Member: Do we leave them too long? The answer to the question is that we do successfully go to six gauges to our dies. We have a very prominent finished gauge of 025. Those dies we cut back to as far as 15, and we think we may be fooled, but we are getting pretty good die life all the way through.

Mr. Cowan: We are only after those people who do not take care of the dies in the first size.

A Member: I believe somewhere in this question there is recommended cutting the dies only three sizes up and dispensing with them. Earlier in the talks, they speak about the diamonds being much smaller, while Mr. Moyers distinctly specifies the diamonds are to be such sizes as to allow cutting six sizes. That might be the reason why three sizes are good on one side and six successful on the other.

A Member: To my knowledge we are not paying a premium price for dies.

Mr. Wind: Gentlemen, are there any questions that you want to put to this panel?

Mr. Pumphrey (Fort Wayne Wire Die Co.): I would like to say something on the Western Electric. We happen to be one of their suppliers. A couple of years ago their chart called for three recuts. Personally, I am one who is in favor of recutting dies in a plant, and if you can get three or five recuts, or six, as they say, that is very good. If their chart does call for six recuts now, it is perhaps due to so many rounds I have had with their engineers. They don't get a premium die. They get the same die everybody else is buying, and for the years I spent in the wire mill, I always got from three to six recuts. I think you can still get them and with the present mounting it is much better than before. There are chances of medium dies even going higher, and on .000 sizes you should get more than that.

I have been working in the mill for years and making dies for the last thirty years.

Mr. Wind: Has anybody got any questions they would like to ask?

A Member: We are in the business of drawing low carbon steel wire, at somewhat accelerated speeds nowadays. Are there any tests available as to the cost per ton, comparing diamond dies and carbide dies? Our most popular sizes are 010.

Mr. Wind: Does anybody here on the panel wish to answer that question?

Mr. Cowan: I would answer it in this way: you can check that better than anybody else by doing this: For instance, you know how many carbide dies you are using in a week and you know how many people it takes to service them. With the amount of money involved in labor, plus the cost of carbide you buy you can isolate two machines and run diamond in one, carbide in the other. At the end of your test run you will know how many pounds of wire each has produced, and what it cost you. Take into consideration the condition of the dies after the test depreciation of the diamonds accordingly.

A Member: We are trying to get out of doing that experimenting ourselves. Thank you.

Mr. Wind: Does anyone else have a question?

Mr. Leveridge: Would you take this lack of objection, Mr. Moderator, as an indication that the wire drawers agree with the Die Makers Committee on all the points that have been raised?

Mr. Cowan: Are there any questions on the paper that Mr. Leveridge presented to you?

Mr. Leveridge: Would you take the silence as an indication that the die makers have given the facts all the way through, and that the wire producers are to blame for short life, when they do get short life in their dies?

Hairpins

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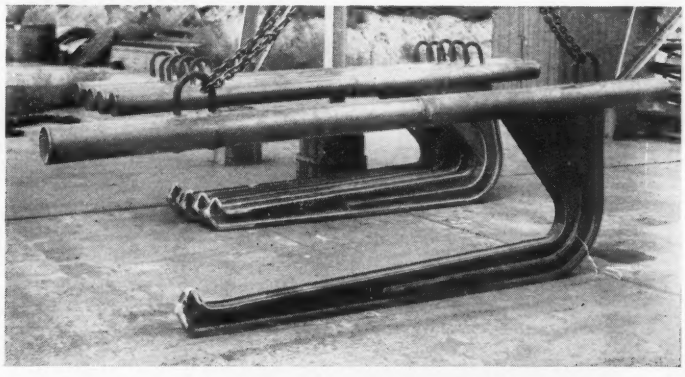

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A Member: I take exception to one statement that was made about either using all diamonds in a series or all carbides in a series. We, as a standard procedure, use diamonds and carbides together in the same machine. As far as the lubrication goes, I believe we have definitely proved that it isn't a major factor in the die life of either one. We boiled it down to this fact: where we put carbides and diamonds together in a machine we must have enough carbides so that as the first die wears oversize it will not only affect the wire going through the next die, but the fact that it becomes oversized tends to wear each successive die oversize.

Our big problem is to pull the carbide dies out of the set before the last carbide wears oversize, and we do that by checking the wire going through the carbide dies at definite times and we have had very good success in protecting our diamonds.

The thing that we have the biggest trouble with, and I would like to get somebody to say something on it, and I feel that I have tied it down, is with broken diamonds. To eliminate the thought that it might be carbides, I will mention the fact that we have a machine that uses all diamonds and we still have broken diamond dies.

The diamond, as it is first used, looks like a good die, when put in the machine, and after three or four days it will be broken. In my opinion the shock of starting and stopping the machine is breaking the diamond. We could make shims to put in the machine to hold that die solid, so that as the machine stops and backs up, the die backs up, and when it started again we would not get that shock. I don't know what these other fellows do, but I would like to hear some discussion on that, because that seems to be our major problem.

I would like to know how to protect these dies so we wouldn't get this high breakage in actually drawing the wire in the machine.

Mr. Wind: Mr. Stewart, would you want to answer that?

Mr. George Stewart: I haven't had any experience to any great extent on copper, but my experience is limited to tungsten and molybdenum drawing, and I, myself, think that is much harder on dies than copper. Our breakage is relatively small. I don't have the experience on copper to answer that.

Mr. Leveridge: Wouldn't there be any questions to come on tungsten and molybdenum, so that we could have something on that?

A Member: Could I ask Mr. Atwater what size machine he uses and at what speed it runs?

A Member: We use a Syncro B-16 machine, and we draw at a range of .128 to .0159. The speed of the machine is between 4000 and 5000 feet per minute, and our breakdown wire will take 16.

A Member: Do you mean on a 16 die machine, you put carbides in that; I mean the one you use both carbides and diamonds?

A Member: That is a C-12, and we use five carbides and the remainder diamonds. We try to use enough carbides, running from .064 to .0063.

A Member: I will admit if you put two carbides in a C-12 machine and start it up, and the rest are diamonds, and you run it for one day, under normal operating conditions, if that machine runs, you will break at least two diamonds. I have done it and I know it can be done. It is very easy. We find if you put at least five carbides in, by the time the wire breaks, due to heavy range or a weld that won't go through that die, you still have plenty of room to go before hurting the first diamond. In other words, the wire won't run through the carbides, the first carbide die run up before the last one has gone oversize. The diamonds are always protected if you have enough carbides ahead of the first diamond.

Mr. Cowan: Is it in your intermediate size that the diamonds are breaking?

A Member: I eliminated the carbide end of it, so we wouldn't get confused. This is using it in a Syncro B-16 machine, 16 diamonds and no carbides.

Mr. Cowan: When does it start?

A Member: Generally when the first three dies break down or the two after that, and those dies range in the neighborhood of 045 to 072.

Now the die looks good when we start with it and for no apparent reason it breaks, but we are having mechanical trouble with the machine. We have more trouble in breaking dies than when the machine runs continuously, but it seems to substantiate the fact that you get more shock where you are starting and stopping all the time.

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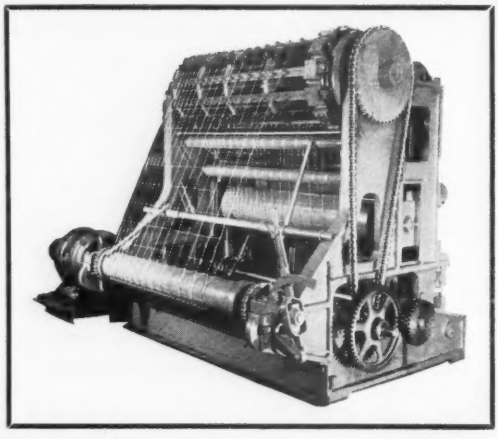

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Mr. Cowan: That is a common fault. It happens with a number of people in drawing wire. You should start that machine on slow speed.

A Member: You can't do it. I have tried. There are two things: you have to lock the dies in or adjust the slots to accommodate the present made dies, or another alternate method I have tried to inaugurate and I have a little trouble with it, is to get you fellows to get a bigger die casing to fit the slot. It would help us out as far as inhibiting the shock is concerned.

A Member: What fat content do you have in your solution in that machine?

A Member: We range about two per cent.

A Member: Cut it down to 1½ per cent. You can get too much fat and you can get too little.

A Member: We have another problem that I don't want to get involved in, where you are running fine wire and heavy wire in the same bank, you have to hit an intermediate step. That 2 per cent is total fat. We run half a per cent free fat and one and a half soap, and all sizes run pretty well for us in that range.

Mr. Cowan: May I ask this,—have you tried using a slightly different draft on the first three dies and experimented in die shapes?

A Member: How do you mean that?

(Answer Missing:) Change the percentage of draft slightly where the trouble begins. It might help.

A Member: Our incoming wire goes faster and a lot of times it has a disadvantage, because you may have weld trouble or possibly if you have thin lubrication, you might have more chance of a crossover. I don't just know if that would hurt. I don't see how it would help.

Mr. Cowan: I was just "thinking outloud," while we are talking about it.

A Member: I think it is a matter of case size or adjusting the machines to fit the dies, which is a problem that would help the industry as a whole. That is a problem that would save us money.

Mr. Cowan: We are willing to go along with you on the casing size.

A Member: We have had a whole lot of argument. It isn't a case where we have a "spec" out on it and everybody sitting out there has agreed to make these dies, but when we get them they are not that size.

I don't want to hold up this meeting, but I think that is a question that ought to be considered, and some solution arrived at. It would help us all out, not only the wire drawers but the manufacturers as well. It is just a matter of getting together, and maybe it is with the machines or the people who make the machines.

Mr. Cowan: Do you want standardization?

A Member: That is right. If you people who draw wire would look into it a little, I think you would find similar problems to the one I am presenting now, not only on copper, but other metals.

All I want to do is to see if there is anybody else here who has that trouble. I would like to know about it myself. It is for my information.

Mr. Cowan: How about the people in the audience who draw copper? Do you have anything to say on this?

Mr. Wind: Is there anybody else who can throw some light on that question?

—No Questions—

Mr. Leveridge: Is there something on the tungsten and molybdenum? We have an expert on the panel. Is there anybody here who would like to ask some questions on the drawing of tungsten wire?

A Member: One opinion was expressed, and I would like to hear some more discussion about it, and that is the combination use of tungsten carbide and diamond dies. The statement was made that it never should be done, but after listening to some of the other discussions about the room this afternoon, I think it is being done, and I would like to hear some more opinions about that.

Mr. Wind: Is there anybody out there who draws wire with a combination of tungsten carbide and diamond dies who would like to express himself?

Mr. Albert Richards: We do draw tungsten that way, but we use tungsten carbide down to about .009. On nine-tenths of a thousand we use diamond. We have it measured all the time.

A Member: We use tungsten carbide dies with our diamond dies in our C machine, and we do what this gentleman said, we control the breakage of our diamond dies by very closely checking the tungsten carbide. When the last tungsten carbide set starts to get

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larger, we change those, and we have had very good success with not breaking our large diamonds.

Mr. Wind: Thank you.

Is there anybody else who has any questions to ask? Remember, this is really your meeting, so we are here to answer your questions.

A Member: I might also add this about having trouble with diamond dies and thinking it is impact that is causing it instead of using a diamond with a larger casing: we have had our machine shop make up some small sleeves that we put over the diamond dies, and we tighten them in with a little Allen screw and this enlarges the casing so it fits in the slot of the machine better and you don't get so much impact.

Mr. Wind: Thank you for the suggestion.

A Member: I would like to hear something a little bit about controlling contours on diamond dies. We have seen pictures here that indicate for drawing copper, for example, an 18 degree approach and a 50 per cent bearing.

Are there any scientific methods that have been developed with diamond dies so far to actually measure those things or control them, other than visual examination?

Mr. Otis Ferrier: I have nothing to say on that. We measure the bearing and the contour. This has to be done by microscope or the loop. That will measure the contour and the bearing exactly.

A Member: I have another question. This question has to do with electric drilling or processing of diamond dies, and I am wondering as to the electric method, or whether anyone has found any application of such methods to recutting dies from one size to the next?

Mr. Cowan: I can answer that for you. There is no method, other than drilling the bearing itself.

A Member: The initial piercing?

Mr. Cowan: That's right, that can be done too.

A Member: As to the use of tungsten carbide dies and diamond dies in the same machine, we followed that practice at Hawthorne for a considerable number of years in our intermediate machines and found eventually that it paid to use diamonds throughout, purely on the basis of economy in processing the dies. We didn't find any particular disability in the operation of the machines, but it was more economical to replace the carbide dies with diamond dies.

Mr. Cowan: Thank you. That answered our question. We wanted to know that.

A Member: I just want to clear up this one point about mixing dies in a machine. It isn't a matter of not wanting to put all diamond dies in a machine with us, it is the fact we just don't have the large size dies as yet to fill out all our big machines, so in our case it is a case of necessity, and, as far as I know, we haven't had any trouble. But from the economic standpoint, the gentleman from Western Electric is absolutely correct, because it means you have a lot more down time or setup time (using carbides in the line-up with diamonds). I assume that is what you mean, isn't it?

A Member: Actually, we proved it (all diamond dies) an economy in processing dies alone and without counting the saving on the machines.

A Member: We fully intend to go to 100 per cent use of diamond dies. The statement was made that the dies shouldn't be mixed, and I know after controlling it as closely as they have, we are not having so much breakage trouble. So I just wanted to make that point.

It is a matter of necessity now that we do it.

Mr. Leveridge: I think that it would be unfortunate to end here, because it comes back to an agreement with the die makers' paper—the statement that it is a matter of necessity. We would like to find something controversial, some place where we are wrong. That helps a great deal for our progress and service.

A Member: Is there any comparative data on the economy obtained with tungsten carbide dies and diamond dies on the same material and the same sizes?

Mr. Wind: I don't know whether there is anybody here on the panel who could answer that question. Perhaps there is somebody out there, who can tell us what poundage one could get on carbide dies versus diamond dies on drawing a cut of wire?

A Member: We have found in the ranges of 15 to 18 gauge diamond dies, that they have a life of approximately 60 times that of carbide dies.

A Member: Mr. Wind, it was brought up awhile ago, and I don't think it was

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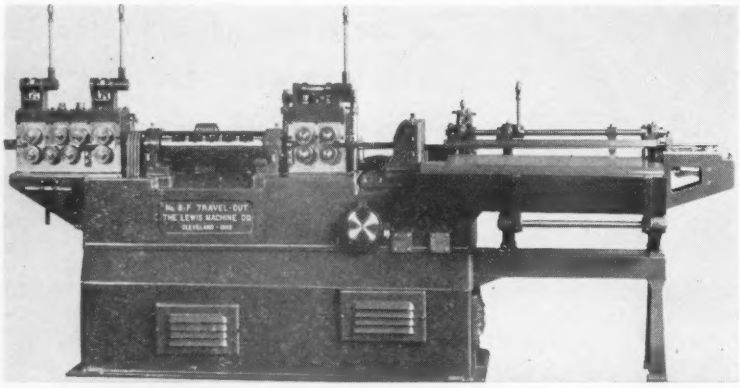

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threshed out as it should have been, and that is the control on contours. We do have a comparator and we can give you, not exactly 20, but between 19 and 20, and quite a few of the die companies I think use that. We use wood metal, and have it enlarged and we can measure that and also measure our bearing length on the larger dies. When you get down to finer dies, it is a little harder, but a lot is controlled in grinding your needles on your drilling, although you can't get it as perfect as you can on carbide. It is impossible to be accurate, but you can get between one and two degrees.

I know the die manufacturers have secrets, as I have found that out, but there is one question that I would like to ask anyway.

There are certain people here who would like you to always buy their diamond powder, but I know you fellows don't do it. You do your own crushing, or at least some of it, and your own grading. What is the most economical and profitable way to do that grading job? Is it the flotation or is it the settling, and so what?

Mr. Cowan: I would like to answer that. It is if you don't use large quantities, most economical to buy it. I don't sell it, but I make part of it myself, and also buy some; and I find they can make it far more scientifically than I can myself.

A Member: Maybe the panel, before they would answer that, would like to know that the Western Electric makes its own dies at Baltimore. Maybe that should not be answered, unless you don't know they make part of their own dies down there.

A Member: Yes, I know they do, but I don't know too much about the auxiliary equipment. They do have a flotation method grading process that they use, but I did bring that question in for one reason, to get the answer that I did get very quickly, that it is a lot better to buy it.

We have been going into the diamond powder buying situation, and we are wondering if that isn't true. I would like to know whether our contention is right or whether it is wrong. I am beginning to think buying it is the best thing to do from the answer I have gotten and the only answer I have gotten.

A Member: The answer to that question from a diamond distributor, is, if this plant can use all the powder they make, and it would be economical, but there certainly will be large gradings where they can't use it all, and that is pretty much a waste. In Baltimore they do make their own powder. There will surely be that waste, unless they use all of it.

I would like to hear how many companies that use diamond powder ever examine it themselves or look at the stuff. I have the idea that an extraordinary number do not. It needs to be very precisely graded. You can get the exact size you want if you know the size you want, and I don't think very many companies, including large companies, look at the material or examine it. If they do examine it once, they should be sure that they get the same powder the next time. It is very important but I have found that they do not.

Was that the question that you wanted answered?

A Member: Yes.

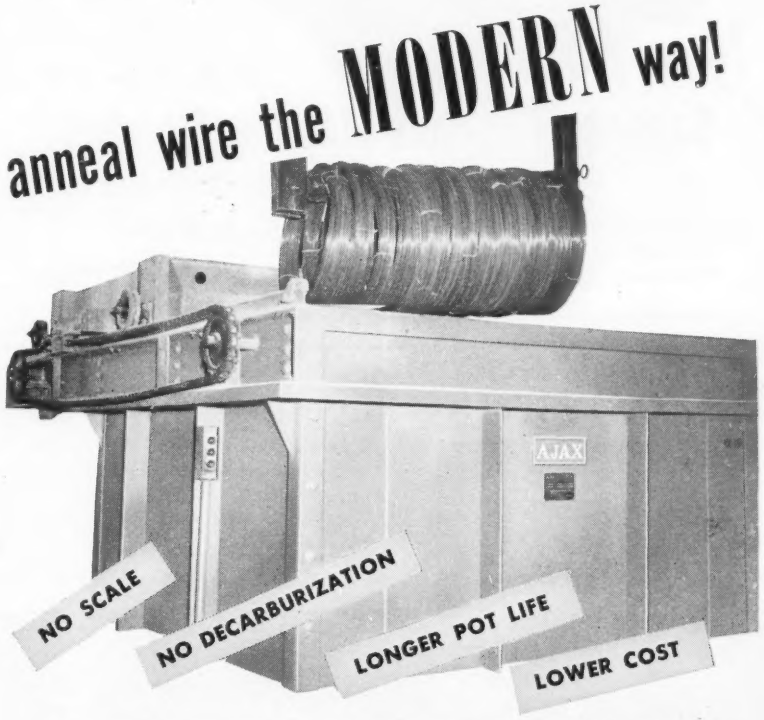
A Member: In yesterday's discussion, there were confusing ideas about profiles, and they suggested trying to pull the wire through the other end of the die. Do any diamond die people feel that way about it?

Mr. Leveridge: Mr. Crum did say that.

I don't know if it is in order at this point. It is an afterthought, but I would like to bring this little question up.

A lot of questions have been brought up. Some people asked me what effect the devaluation of the British Pound Sterling is going to have on the price of diamonds in this country. About two weeks ago our Association (I.D.A.) received a cable for which we had been waiting, the answer to our original inquiry. It was to announce that the syndicate had sent out its new prices to the dealers and tradesmen with whom it was accustomed to do business. We ascertained and published that the syndicate had advanced its prices on diamonds to an extent that would cause the new level to be approximately that of the market in the United States **prior** to devaluation.

This has no relation to the price of the diamonds as delivered by the Corporation in series goods to its customers, but the prices after assortment in this country, come to almost the same on diamond dies stones as prior to devaluation. So no material difference in the



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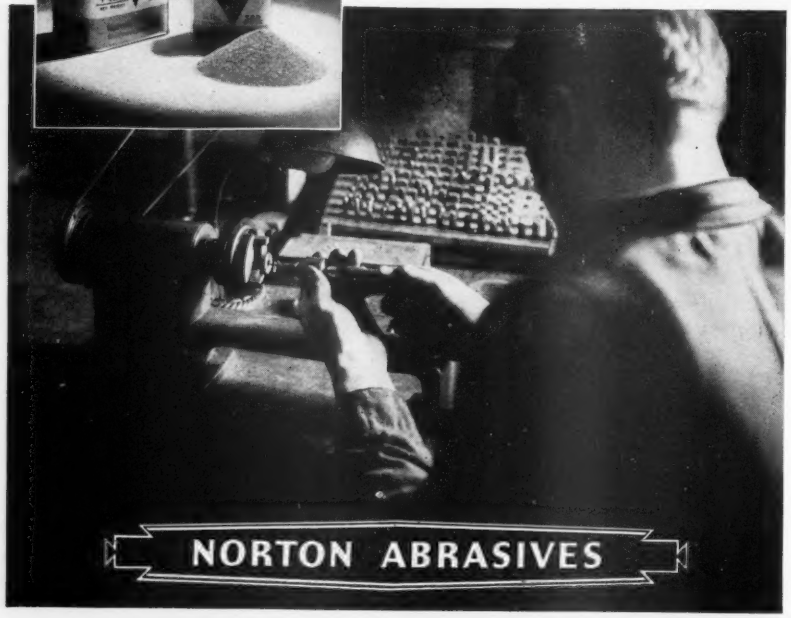

price can be expected there.

Mr. Wind: Do the die men agree with that, that we are not going to get any price advance in diamond dies? Has anybody else any question to ask this body?

(Nods of confirmation by die men on panel referred to price of diamonds, not of the dies, as this question of Mr. Wind's was not in anywise answered.)

Mr. Hedman: The question was asked about measuring of contours on fine wire dies, and I have a little something to offer that might be of help to the person who asked that question. We take a piece of pointed wire and put it through, but not entirely through and we leave about three or four inches sticking out of either end. A drop of acid is applied to the back of each side of the die and allowed to remain for approximately fifteen seconds. The die is then given a rinse and the wire is backed out, leaving the imprint on the wire of the working zone itself, and you can measure the same on the shadowgraph. It also will give you the length of the bearing as well as your drawing angle. You can also use it to check raw rubber on a vulcanizing machine if you need to shadowgraph to compare them. We have done it on both and can gauge the sizes and angle.

Before going, I want to thank the panel for their part and thank the members of the Association for giving their time to us. Thank you.

Mr. Wind: Thank you very much. . . . The meeting was adjourned at five o'clock . . .

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WYLIE BROWN, chairman of the Board of the **Phelps Dodge Copper Products Corporation,** states his belief that the Copper Fabricating Industry can look forward to a good year. In the electrical field, a continuing and probably increasing demand is confidently expected. Public Utilities, other electric power systems, electric transportation systems, and the telephone and telegraph industries still have much to do to catch up from their construction holiday during the wartime years and to provide for normal growth. Rural Electrification and other Government sponsored projects, including the Department of Defense, have extensive programs for 1950.

★ ★ ★

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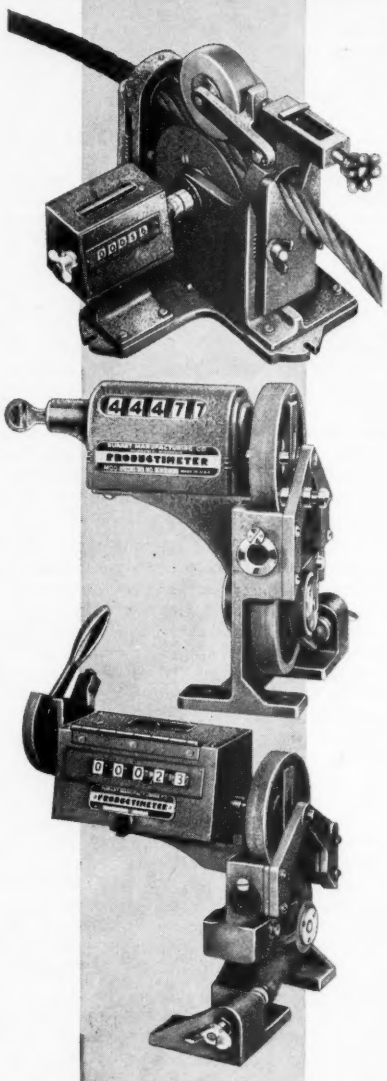

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A Review of Recent Wire Patents

(*Continued from page 154*)

The cable comprises an outer deformable layer of helically wound coreless, twisted strands of thin highly resistant steel wires that are yielding and adapted to support repeated flexion, the wires of each strand being sufficiently loose to allow the tire rubber to enter easily the strand, and a central part constituted by at least one coreless, twisted strand of thin resisting wires and at least one metal wire wound helically round the last mentioned strand to render the central part resistant to axial compression.

★ ★ ★

NO. 2,492,568, ELECTRICAL CONDUCTOR CABLES AND A METHOD OF MAKING CABLES, patented December 27, 1949 by Randall Gillis, Snyder, N. Y., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

A wire core is provided with metal tape folded longitudinally of itself as a sheath about the core with one lateral edge of the tape overlapping the other and a layer of composition over the entire inner surface of the tape between the tape and the core and between the inner face of the overlap of the tape and the outer face of the underlap of the tape, the composition consisting principally of a thermoplastic synthetic resin over the whole layer, and the portion thereof interposed between the overlap and underlap of the tape being cured to be thermosetting and set with a condensation product of a phenol and an aldehyde.

★ ★ ★

NO. 2,492,848, TEMPORARY PROTECTIVE COATING, patented December 27, 1949 by Willie W. Crouch and Joseph A. Delap, Bartlesville, Okla., assignors to Phillips Petroleum Company, a corporation of Delaware.

Iron surfaces are temporarily protected from rusting by applying thereto a film of a composition consisting of the following ingredients in the indicated proportions by weight:

Air-blown petroleum asphalt, penetration 15-30 A.S.T.M @ 77°F.	100
Gilsonite	100
Petrolatum, melting point 137.5°F.	50
Stoddard solvent	300

allowing said composition to evaporate leaving a residual rust-preventing film which is non-tacky, which is resistant to rubbing off at temperatures up to 150°F., which is said to be firmly adherent, non-brittle, non-chipping and non-chalking, and which does not crack, check or peel, allowing the residual film to remain in place during the period while protection against rusting is desired, and at the end of this period removing the film by dissolution in a volatile aliphatic essentially paraffinic liquid hydrocarbon solvent.

★ ★ ★

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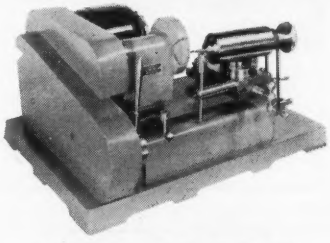

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Wire Association Proceedings, Technical Sessions Discussions on the Tungsten Carbide Die Symposium

(*Continued from page* 143)

which has a tensile strength of 300,000 pounds per square inch. We are using a bearing of 65 to 75 per cent length for this reason, that when the wire starts to make that circle at the top, we take it out and polish that angle down a little, getting the ring out of it. We can use the die again because the size has not suffered, and when that ring forms again we polish it down a little bit more and get down to 25 or 20 per cent bearing. We do very little work on that die, except to take out the ring. I don't know whether that would be the tendency or not, because we just started doing it. We may do that with some of the high tensile wire and the low tensile wire. I am always open to conviction. When I get home, I will try no bearing and see how it works.

Chairman Crum: It is certainly essential that we keep trying new methods and not blindly accept the time honored ones per se.

A Member: I am a copper man, not a steel man, and probably it has no bearing on this situation as far as you fellows go, but this is one sidelight that might help a little bit as far as long bearings go. We have experimented with bearings up to 100 or 125 per cent of the diameter and found as the bearing increases, the pull of the wire increases also. The shorter the bearing, the easier the wire draws through the die, providing we stay on the accepted reduction per die. We have also found on long bearing dies that as the bearing increases and the pull increases, the wire has a tendency to suck under size in the bearing of the die, and in copper especially it seems to deform the copper in such a way that grooving of the bearing, or the pull-out part, as we call it, becomes prominent almost immediately.

We have cut our die life as high as 60 per cent by using 125 per cent bearing. As the bearing is shortened up, the die life is the reciprocal of that or the opposite of it. It increases.

As far as the approach angle goes in copper, we have experimented with angles in the range of 12 to 20 degrees, and on plotting a curve on an approach angle with relation to die life or pounds of wire drawn within the range of the size, the tolerance of that particular size, we have found that at 16 degrees we get our maximum die life. At 18 degrees it tapers off just a little bit, and at 20 degrees our die life is very poor, and the same goes for the other end of the included angle; at 14 degrees it is a little less and at 12 degrees we have very poor luck.

Now we have considerable breaking of the copper at a 12 degree angle, so I don't know whether that is any help or not, but we have pretty well established 16 degrees as our angle. However, we feel anywhere from 14 to 18 degrees is acceptable, and there is very little difference in the ability to draw the wire without breaking. This is all with the assumption that your lubrication for that particular machine is proper for the speed of your draw.

Chairman Crum: Thank you very much. That covers the copper wire field, and it seems to me there is a lot to back up your remarks.

A Member: I thought a little history might help. Along about 1929 I was given a job of determining what sort of die we should offer for sale. I thought the historical background might help because there haven't been any changes really in die angles since those days. We went into the copper mills first and they were using chilled iron dies. We went to several mills and obtained from them the dies which were working in the machines. In all cases we found that the original angle in the die from mill to mill differed, but after the die had taken what they called a set, it was taken out of the machine and we took them back and examined them and found, without exception, no matter which copper mill we used for our source of dies, the angle which was established in the die by the copper was 16 degrees. Therefore, we set 16 degrees as the angle we would use in the dies which we sold. Likewise we did the same thing in the steel, and we drew wire under careful supervision and with observation on each shift until we drew something over 7500 tons of steel wire.

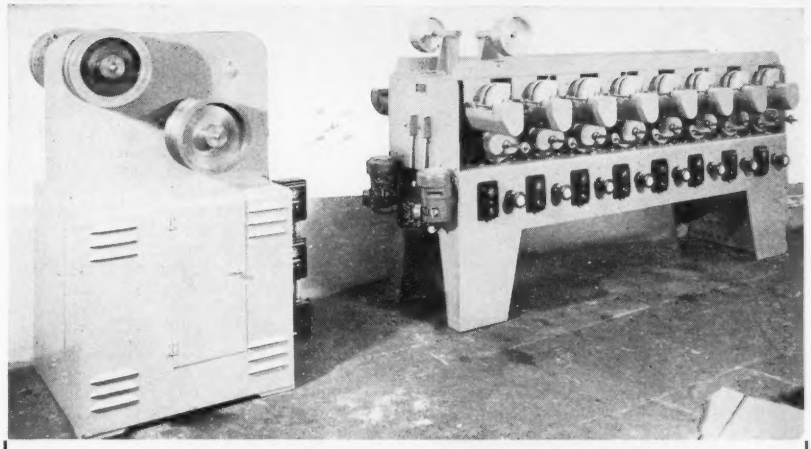
We considered that was a sizeable amount of steel wire and it was split about 50-50 between high carbon and low carbon. We easily showed from the figures we obtained at that time that 12 degrees gave the best wire and at the same time low die cost. We were after high quality in the product, and that is on wire over .4 carbon. We used 12 degrees and that is the way that angle was established.

A Member: Wasn't that a very slow speed?

A Member: No, it wasn't.

Let me explain that. I said on the copper wire we started out with a 16 degree carbide die and then we went into the steel mill 16 degree carbide die. We drew approximately 7500 tons of steel wire and established during that process that 12 degrees was the most satisfactory angle for high quality, high carbon wire, where the wire was over .4 carbon. Under .4 carbon, it was easily determinable from the fact we developed that a 16 degree angle gave the best results and it was interesting to me today, as I have been out of field work for quite awhile now, to find that this board of experts still tells us the angles established from shop experience those days are still in use.

Now I would like to say just one word about bearings. Mr. Glen touched on it somewhat. The bearing length was established at the same time that we established the length that gave us the best wire and the longest die life; on copper it was half a diameter and on high carbon steel it was two-thirds and on low carbon steel a half. You will



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notice that the copper wire die 16, and a half a diameter bearing length, and the low carbon steel die, 16 degree angle and a half the diameter length and on the high carbon 12 degrees and a two-thirds bearing length.

Now Mr. Voightlander has touched on the reason for that. To get the high quality wire, you don't want a ring in the die. When that ring starts to form, it is best for the end product to get it out. It takes but a few minutes to do it. And so the length of the bearing was established which would give us the best wire and then it left us some bearing length to whittle down as we worked the approach angle and reworked the approach angle to remove the ring.

Chairman Crum: That covers the history of the carbide die very nicely. I am sure that the fellows making up our board of experts are all broad-minded. This paper had to be a concensus and I am sure they all want to go home with something new to try out. I think I speak for these fellows. They are not just dead set on doing what has been done over the ages, but they are open to conviction.

I am afraid we will have to draw this discussion to a close, as interesting as it has been.

There are, of course, many other phases of this subject which we could discuss, but our time is up, so I am going to turn the meeting back to Mr. Glen.

Mr. A. E. Glen: It has all been most interesting and enlightening, and I think these gentlemen at the table here are deserving of a hearty applause. (Applause)

. . . The meeting was adjourned at twelve o'clock . . .

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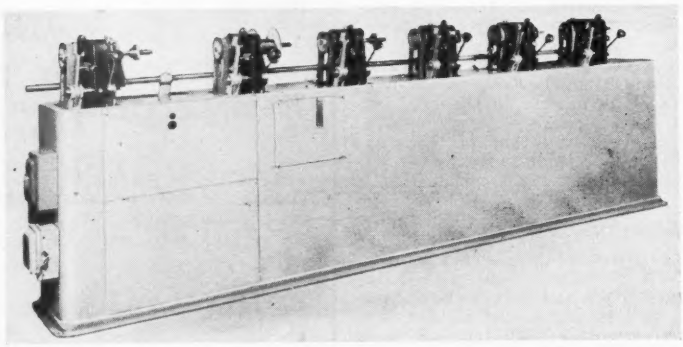

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(*Continued from Page 140*)

will cause the wire to be drawn correctly. The wire will clear from the point where the bearing starts, eliminating overheating and all of the other ills caused by Die #1.

★ ★ ★

IT is just as easy to make the die correctly as it is to make it incorrectly so there is no valid reason for having a die go out to the mill in the condition of Die #1. This seemingly unimportant die condition is the reason for a lot of poor die performance, so let's WATCH IT.

★ ★ ★

E. Miller

4. The Back Relief.

HERE again is a part of the die that too often is considered unimportant. In the fine wire dies it is admittedly less important than it is in the larger dies. As long as the corner at the back end of the bearing is broken a fine wire die will perform satisfactorily. Eliminating or cutting down on the back relief of the larger dies will often cause the carbide to crack. The reason for this is obvious when you compare a correctly made die with one which is incorrect. The cross section at the back end of the bearing on Die #2 is stronger by 75° than Die #1.

★ ★ ★

ANOTHER function of the back relief is to eliminate the scratchy wire resulting from the wire passing over a sharp corner as it leaves the die. The back relief is also important on continuous draw machines as the wire backs up when the machine is shut down. Lack of back relief causes the wire to scratch when the machine is started up again and causes slivers in succeeding dies.

★ ★ ★

THE specifications of a wire die will vary according to the type of wire, the amount of draft and the type of finish required on the wire.

★ ★ ★

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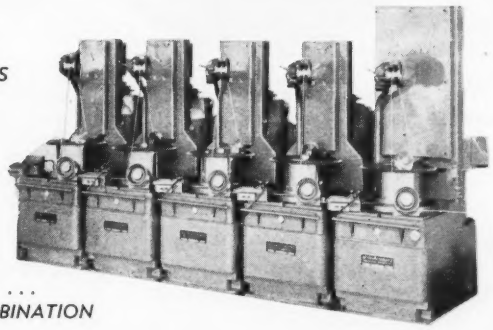

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IF the basic fundamentals of the dies as presented here are adhered to, we know that should trouble occur we can look for sources other than dies.

★ ★ ★

E. J. Crum

ASSUMING our dies are suitable for our particular type of wire, what other factors should be closely controlled to insure good drawing conditions?

★ ★ ★

G. Fecsen

FIRST, let us look at our patenting and annealing conditions. Are they closely controlled? For instance, supposing the wire is subjected to too high a heat and a deeper than normal scale forms. This scale will not be entirely removed under normal cleaning. After coating and while being drawn, this scale will flake off causing a metal to metal contact between the wire and the die. This is one of the causes of poor die life. This same thing can happen if the annealing is O.K. but the cleaning is not thorough enough.

★ ★ ★

QUITE often after wire has been coated, it is allowed to wait around too long before drawing and severe rust spots appear. As this wire is drawn the rust particles act as an abrasive and cause the dies to wear excessively. A heavy sul-coating on high carbon steel wire will cut down on die life considerably although it doesn't seem to on low carbon wire.

★ ★ ★

ALTHOUGH misalignment of die blocks is not found too frequently, it is still another source of trouble especially in the older type wire drawing equipment. Mis-

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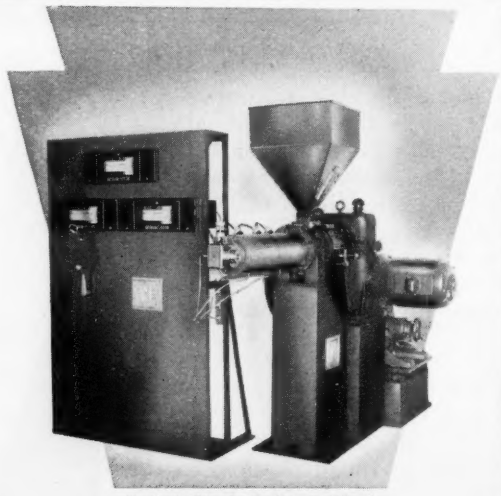

2" Davis-Standard Thermo-Plastic Extruding Machine

alignment will cause out of round wire and an uneven wear of the die.

★ ★ ★

ANOTHER source of trouble is the overheating of a die due to drawing speeds. Actually the overheating itself does not affect the carbide, but the heat does break down the lubricant causing a metal to metal contact between wire and die. As previously mentioned, this causes excessive wear on the die. Another cause of overheated dies is a blocked circulating system in water cooled die blocks. This should be checked frequently as there is no way of telling by merely a glance whether or not the water is circulating.

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23,000 Ft. per Hour @ 6" Lay on New 22" Strander by Clyde Kiess

CLYDE KIESS, owner of **Hughesville Machine and Tool Company,** Hughesville, Pennsylvania, states that two of the 22"—7 wire stranders they installed at the Newark, Ohio, plant of the **Kaiser Aluminum & Chemical Corporation** run at the highest speed this size machine has ever before operated in production. The stranders have been in use for many months at 775 RPM making seven and eight wire Aluminum and Steel re-enforced R.E.A. Cable.

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IMPORTANT changes in design and methods were employed in the manufacture of these machines comprising centrifugal cast tubes of high strength alloy steel, elliptical shaped windows for spool loading, that greatly increase the strength of the tube, large support rollers and brake areas, silent drive gear box and other improved features. The double capstan haul-offs are driven by P.I.V. variable chain drive and change-gear box, providing a variable constant lay range of 12 to 1 and the reel stands are the new Hughesville Hydraulic-lift retractable reel pintle type.

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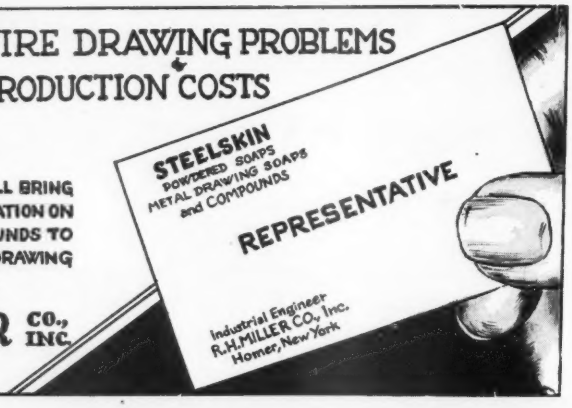

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Fume Elimination for Wire Enameling Ovens

(*Continued from page 132*)

ventilation permissible for insurance approval and exhausting directly from a 700 deg. F. oven, the discharge temperature from the catalyst can be expected to approach 1300 deg. F. Under normal operation, however, somewhat greater dilution of the fumes is practiced. Also, the ventilating system on most wire enameling ovens is arranged to permit infiltration of room air into the exhaust manifold, thereby reducing both the entry and discharge temperatures of the catalyst.

★ ★ ★

NO prediction is made at this time on the length of life of the catalytic activity. This may depend upon the nature of hydrocarbons and amount and type of foreign materials present. However, should deactivation occur, the catalyst element can be reactivated on an exchange basis at reasonable cost.

★ ★ ★

ON the basis of the initial installations on wire enameling ovens, the following results can therefore be expected:

1. **Elimination of air pollution complaints.**
2. **Elimination of recondensation of fumes in the exhaust ducts.**
3. **With oven exhaust temperatures of approximately 500 deg. F. or higher, complete incineration can be obtained without the addition of energy from external sources.**
4. **Where exhaust temperatures are appreciably below 500 deg. F., a small amount of additional heat can be applied to the exhaust stream to attain initial auto-ignition temperature of 500 deg. F. Once combustion has been established on the catalyst, the external heat energy input can be reduced in inverse ratio to fume concentration.**
5. **The outside stacks need be only of such height as to provide the necessary draft since the need for fume dispersion has been eliminated.**

★ ★ ★

EXTENSIVE laboratory tests have been made on the catalyst under a wide range of operating temperatures, fume concentrations, and types of hydrocarbon fumes. Possibilities for wider adaptability

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are most promising. Full appreciation of the potentialities can be realized, however, only after more varied and extensive field operating experience. It is already recognized that the application of this type of incinerator is suitable primarily to hydrocarbon fumes comparatively free of unburnable solids, such as those discharged from wire enameling ovens.

★ ★ ★

THE catalytic fume incinerator is a development resulting from a joint research project carried on over a four-year period by the writer and **H. R. Suter,** Associate Research Director, Wyandotte Chemical Company.

★ ★ ★

Electrical Resistance Alloys

USE of 80 per cent nickel—20 per cent chromium electrical resistance wire serving as the principal operating element in such items as stoves, hot water heaters and domestic appliances are expected to increase with the further expansion of markets for these appliances, particularly in the United States.

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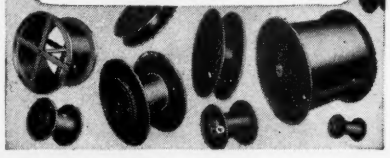

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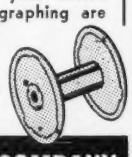

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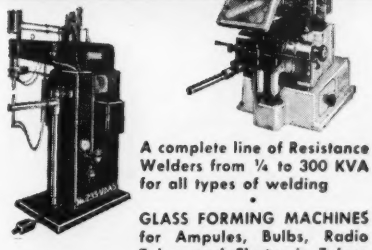

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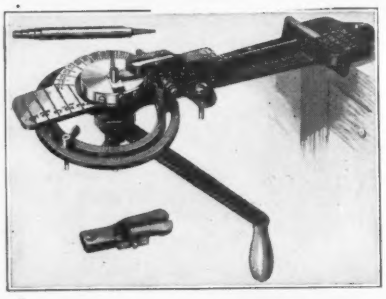

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An Investigation of the Weavability of Wire with Observations on the Defects of Wire and Wire Cloth

(*Continued from page* 129)

edges on wire cloth is an effect resulting from the elongation of the edge warp wires of cloth woven on shuttle type looms; this ripple is especially harmful to filter cloth which should lie perfectly flat, and therefore, the author has called it the "ripple in filter cloth." Theories for the cause of the elongation of the edge warp wires are based on the fact that the crimping of the fill wires causes the edge warp wires to be pulled toward the center of the cloth. Measurements of the tensile forces in the warp wires may show just when this pulling and elongation take place and may lead to the correction of this defect.

* * *

WIRE cloth tests usually depend upon the use to which the cloth is put. The Michigan Wire Cloth Company has run tests on its filter cloth to determine the maximum size of particle that will pass through it and to determine the rate of flow of water through it. Atmospheric exposure tests have been run on wire fencing, [26] and on insect screening, [27]. However, R. W. Bacon describes a large number of physical tests that may be applied to wire cloth, [28].

* * *

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* * *

Weavability

WEAVABILITY is a term coined by the author to describe the ability of a wire to be wound

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on a bobbin or spool, crimped, and woven into cloth. The term refers to the ease with which a wire may be handled and woven, as well as to the ability of a wire to stand crimping. However, from a practical metallurgical stand-point, the term refers to the ease of crimping and to the ability of a wire to be crimped without breaking. The author believes that weavability is independent of wire size. Weavability should be similar to workability in that the energy required to crimp a certain weight of wire should be the same for large wires as for small wires of the same weavability. It should be pointed out that shear, tensile, and compressive forces are all present when a wire is crimped.

* * *

Properties Related to Weavability

WEAVABILITY has been defined as that group of characteristics that determine the ease with which a wire may be fabricated into cloth. Some of these properties are plasticity, stiffness, formability, workability, and uniformity.

* * *

PLASTICITY is the ability of a material to be deformed permanently without rupture. Percent elongation and percent reduction of area, as obtained from a tensile test, are considered to be good measures of plasticity. The author believes that percent elongation requirements should be included in all specifications for weaving wire. Malleability is that form of plasticity which is involved when wires are crushed as in severe crimping operations.

* * *

STIFFNESS is the ability of a material to resist bending forces. In almost all wire weaving operations, the wires used are severely bent and in some operations the wires are bent and actually crushed. The transverse-crimp-sensitivity test has shown that resistance to bending or stiffness is an excellent measure of weavability. The modulus of elas-

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2514 Vestry Ave., Cleveland 13, Ohio

ticity is a measure of stiffness in the elastic range, but the author knows of no measure of stiffness in the plastic range except the values produced by a stiffness tester.

★ ★ ★

FORMABILITY is the capacity of a material to be fashioned into a shape without fracturing. It was described earlier as "certain combinations of elastic limit, tensile strength, and elongation." Formability is a basic requirement of deep drawing steels. A high tensile strength, a high elastic limit, and a low elongation are conducive to poor formability. High carbon, "Superloy" wires may be said to have poorer formability than common annealed wires, because they cannot be so severely crimped without fracturing.

★ ★ ★

WORKABILITY has sometimes been defined as the energy required to deform a metal under standard conditions. In this sense it is synonymous with "toughness." The energy required to rupture a material is called the "modulus of toughness" and is approximately equal to the product of tensile strength, elastic limit, and percent elongation divided by 200. Hardness as measured by a "hardness tester" is considered to be a good measure of workability, but the term "hardness" as used by wire weavers usually refers to stiffness. The energy required to deform a cubic inch of metal in inch-pounds per cubic inch is numerically equal to the force required to deform it in pounds per square inch, [20]. It is interesting to note that the units of the "modulus of toughness" are inch-pounds per cubic inch; and that the units of hardness and of the transverse-crimp-sensitivity constant, k, are pounds per square inch.

★ ★ ★

ANOTHER fundamental property related to ease of weaving is uniformity. And uniformity with regard to the elastic limit and stiffness are especially important. If the elastic limit and stiffness of the warp wires on a loom are not

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uniform, then the mesh count of the cloth woven on that loom will be uneven. Non-uniformity in the fill wires makes the cloth bumpy or streaked, and sometimes such wire can be woven only with great difficulty. Today some wire weaving plants specify wire with an elastic limit falling within definite limits, [24]. A certain degree of uniformity with regard to size, roundness, tensile strength, elastic limit, elongation, toughness, stiffness, hardness, and surface condition are all absolutely essential in the weaving of wire cloth. Uniformity of these properties is often more important than the magnitude of the properties.

★ ★ ★

OTHER values that have been used as measures of weavability are the tensile load at 15 percent elongation of a wire and the number of reverse bends that a wire can stand before breaking.

★ ★ ★

Part II will be published in the March 1950 Issue of Wire and Wire Products.

★ ★ ★

The References and Acknowledgments will be published with Part IV of this article.

★ ★ ★

Metal & Thermit Corporation Appointments

METAL & THERMIT CORP., New York, has appointed **Bernard W. Weber** manager of its detinning and electrode manufacturing plant at East Chicago, Ind. **W. S. Leinhardt,** formerly general superintendent, East Chicago plant is now at Metal & Thermit's executive offices in New York as technical assistant to the vice president of production. **William C. Cuntz,** manager, Pittsburgh sales office and warehouse, has been made district manager at Chicago. **Orville T. Barnett,** manager, Newark, N. J., office, has been appointed Pittsburgh district manager. **Robert T. Brown,** who headed technical service on both electrodes and Thermit, has been made district manager at Newark.

★ ★ ★

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The Annual Convention of the WIRE ASSOCIATION

will be held in Baltimore, Md., at the Lord Baltimore Hotel in October, the 18th thru the 22nd, in 1950.

The Program Committee, of which Carl E. Johnson of the Bethlehem Steel Company, is serving as General Chairman, has already organized a program of good ferrous and non-ferrous technical papers with two plant inspection trips. A fine session is anticipated.

This is the time to note on your calendar the time and place of this important meeting. Program details and other data will be published in Wire and Wire Products at a later date.

THE WIRE ASSOCIATION
Richard E. Brown, Executive Secretary
300 MAIN STREET STAMFORD, CONN.

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Norton Co., Worcester, Mass.

ACID INHIBITORS—
(See Inhibitors, Pickling)

ACID-PROOF CONSTRUCTION—
Haveg Corporation, Newark, Del.

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Machy. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy., Inc., Pawtucket, R. I.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Morgan Construction Co., Worcester, Mass.
Ross, J. O., Engr. Corp., New York, N. Y.

BAR STOCK—Stainless Steel
American Steel & Wire Company, Cleveland, Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
U. S. Steel Export Company, New York, N. Y.

BASKETS—Pickling
Rolock, Inc., Fairfield, Conn.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Att'eboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Att'eboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

BORAX—Wire Drawing
Pacific Coast Borax Corp., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES—Pneumatic
Entwistle, Jas. L. Co., Pawtucket, R. I.

CABLE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.

CABLE LACQUERING OVENS—
Industrial Ovens, Inc., Cleveland, O.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CASTINGS—Wire Mill
Scudder, E. J., Fdry. & Mach. Co., Trenton, N.J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
(See Cleaners—Metal)

CLEANERS—Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Metal & Thermit Corp., New York, N. Y.
Oakite Products, Inc., New York, N. Y.
The Parkin Chemical Company, Pittsburgh, Pa.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Holden, A. F., Company, The, New Haven, Conn. and Detroit, Mich.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Bros., Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J. Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

COLD HEADERS—
Joseph Behr & Sons, Inc., Rockford, Ill.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Eastern Carbide Corp., New Rochelle, N. Y.
Hyprez Division, Engis Equipment Co., Chicago, Ill.
Magnus Chemical Co., Garwood, N. J.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Metal & Thermit Corp., New York, N. Y.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corp., Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Inc., Chicago, Ill.
Swift & Company, Chicago, Ill.

CONDUCTORS—Flexible, Electrical
Montgomery Co., The, Windsor Locks, Conn.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CORDS—Electrical, Tinsel Conductor
Montgomery Co., The, Windsor Locks, Conn.

CORROSION PREVENTIVES—
Angier Corporation, The, Framingham, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Adamas, Carbide Corporation, Harrison, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, New York.
Vascoloy-Ramet Corp., North Chicago, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

DIAMONDS—Industrial
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Champion Diamond Co., New York, N. Y.
Diamond Distributors, Inc., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Champion Diamond Co., New York, N. Y.
Diamond Distributors, Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Hyprez Division, Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND TOOLS—
Carboloy Co., Inc., Detroit, Mich.
Champion Diamond Co., New York, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Carbide
(See Dies—Tungsten Carbide)

DIES—Cold Heading
Adamas, Carbide Corporation, Harrison, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Vascoloy-Ramet Corp., No. Chicago, Ill.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Champion Diamond Co., New York, N. Y.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Extrusion
Adamas, Carbide Corporation, Harrison, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth Sterling Steel & Carbide Corp., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Eyelet
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
Adamas, Carbide Corporation, Harrison, N. J.
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Detroit, Mich.
Champion Diamond Co., New York, N. Y.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Special Shapes, Etc.
Adamas, Carbide Corporation, Harrison, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Swaging
Fenn Manufacturing Co., Hartford, Conn.
Sjogren Tool & Machine Co., Inc., Auburn, Mass.

DIES—Tantalum Carbide
Adamas, Carbide Corporation, Harrison, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.

WHERE TO BUY, Continued

DIES—Tube Drawing
Adamas, Carbide Corporation, Harrison, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Adamas, Carbide Corporation, Harrison, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Flange Steel
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N. Y.

ENGINEERS—Consulting Hot Galvanizing
Wallace G. Imhoff Co., The, Los Angeles, Calif.

ENGINEERS—Consulting Spring Design
Carlson, Co., The, New York, N. Y.

ENGINEERS—Consulting Wire Mill
Fisher, Edward J. P., North Jackson, Ohio.
Lewis, Kenneth B., Worcester, Mass.
Wickwire, T. H. Jr., Philadelphia, Pa.

EQUIPMENT—Insulation Testing
Davis, R. L., Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FENCING & FENCES—Wire
Interlocking Fence Co., Morton, Ill.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Company, The, Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, New Haven, Conn. and Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (oil, gas, electric)
Ajax Electric Co., Inc., Philadelphia, Pa.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.

FURNACES—Resistance Heating, Strand
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING EQUIPMENT—
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOOKS—Pickling & Liming
Rolock, Inc., Fairfield, Conn.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Rolock, Inc., Fairfield, Conn.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin Chemical Company, The, Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Machine Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Belding, Heminway, Corticelli Co., New York, N. Y.
Owens Corning Fiberglas Corp., Toledo, O.
Standard Varnish Works, Staten Island, N. Y.
Twitchell, E. W., Philadelphia, Pa.

INSULATING MATERIALS—Paper — For Electric Wire Cable.
Merrimac Paper Co., New York, N. Y.
Twitchell, E. W., Philadelphia, Pa.

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Roos, Tool & Mfg. Co., Montclair, N. J.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Haveg Corp., Newark, Del.

LOOMS—Weaving Wire Cloth
(See Machinery-Weaving Wire Cloth)
Bruckner-Mitchell, Inc., New York, N. Y.

LUBRICANTS — For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

LUMBER—Wire Mill, for lagging and car blocking
North Anson Reel Co., North Anson, Maine.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Barbed Wire
Glader Machine Works, Chicago, Ill.
Wean Engineering Co., Cleveland, Ohio.

MACHINERY—Bead Wrapping
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Braiding
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Brazing
Eisler Engineering Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Fenn Manufacturing Co., Hartford, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., The, Bridgeport, Conn.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Coilers
Boyd & Sons Manufacturing Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Fenn Manufacturing Co., Hartford, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (used), New York, N. Y.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Machinery, Inc., Pawtucket, R. I.

MACHINERY—Cold Heading
(See Cold Headers)

MACHINERY—Copper Wire Drawing and Rolling
Aetna-Standard Engineering Co., Youngstown, Ohio.
American Insulating Mach'y Co., Phila., Pa.
Fenn Manufacturing Co., Hartford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Ruesch, H. J. Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
National Erie Corp., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio.
Mettler Machine Tool, Inc., New Haven, Conn.
National Mach'y Exch. (Used) New York, N. Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Die Making
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Roos, Tool & Mfg. Co., Montclair, N. J.
Wayne Wire Die Co., Hillside, N. J.
Wickman, A. C., Ltd., Coventry, England.

MACHINERY—Draw Benches
Aetna-Standard Engineering Co., Youngstown, Ohio.
Fenn Manufacturing Co., Hartford, Conn.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Edging
Fenn Manufacturing Co., Hartford, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
National Erie Co., Erie, Pa.
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Fence
Blashill, Arthur, Woodstock, Ont., Canada.
Glader, Wm., Machine Works, Chicago, Ill.
Interlocking Fence Co., Morton, Ill.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Fenn Manufacturing Co., Hartford, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
National Erie Co., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Interlocking Fence Co., Morton, Ill.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Fenn Manufacturing Co., Hartford, Conn.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Pickling
Rolock, Inc., Fairfield, Conn.

MACHINERY—Pointing
Aetna-Standard Engineering Co., Youngstown, Ohio.
Fenn Manufacturing Co., Hartford, Conn.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Poultry Wire Fencing
Interlocking Fence Co., Morton, Ill.

MACHINERY—Rod Mill
Fenn Manufacturing Co., Hartford, Conn.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rolling Mill
Fenn Manufacturing Co., Hartford, Conn.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rubber Insulating
Royle, John & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Screw Wire
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Fenn Manufacturing Co., Hartford, Conn.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Mystic, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Boyd & Sons Manufacturing Co., Phila., Pa
Bruckner-Mitchell, Inc., New York, N. Y.
Davis, R. L. Electric Co., Wallingford, Conn.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Mach'y Exch. (Used), New York, N.Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Lewis Machine Co., The, Cleveland, Ohio.
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N.Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Stranding
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Forming
Wickman, A. C., Ltd., Coventry, England.

MACHINERY—Strip Steel
Aetna-Standard Engineering Co., Youngstown, Ohio.
Fenn Manufacturing Co., Hartford, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Swaging
Fenn Manufacturing Co., Hartford, Conn.
National Erie Corp., Erie, Pa.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

WHERE TO BUY, Continued

MACHINERY—Testing Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L. Elec. Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Co., Cleveland, Ohio.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Fenn Manufacturing Co., Hartford, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Marshall-Richards Machine Company, Ltd., Trenton, N. J.

MACHINERY—Weaving Wire Cloth
Bruckner-Mitchell, Inc., New York, N. Y.

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Bruckner-Mitchell, Inc., New York, N. Y.
Davis, R. L. Electric Co., Wallingford, Conn.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply, Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Aetna-Standard Engineering Co., Youngstown, Ohio.
Davis, R. L. Electric Co., Wallingford, Conn.
Fenn Manufacturing Co., Hartford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio.
Marshall-Richards Machine Company, Ltd., Trenton, N. J.
Standard Machinery Co., Mystic, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.
Kilmer, M. D., & Co., Cleveland, Ohio.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, Ohio.
American Insulating Mach'y Co., Phila., Pa.
Fenn Manufacturing Co., Hartford, Conn.
Marshall-Richards Machine Company, Ltd., Trenton, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Fenn Manufacturing Co., Hartford, Conn.
Kilmer, M. D. & Co., Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Wickman, A. C., Ltd., Coventry, England.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N.Y.

MACHINERY—Wrapping Straight Lengths and Tubing
Angier Corporation, The, Framingham, Mass.
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Wrapping Wire Coils
Angier Corporation, The, Framingham, Mass.
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem, Rolling & Edging
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Co., Cleveland, Ohio.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling, John A. Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Dehydrogenizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D.C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin Chemical Co., The, Pittsburgh, Pa.

PICKLING—Hooks, etc. Acid Resisting
Rolock, Inc., Fairfield, Conn.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

PICKLING TANK LININGS—
Haveg Corp., Newark, Del.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

PNEUMATIC CYLINDERS—
Entwistle, James L. Co., Pawtucket, R. I.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio.

POTS—Lead Melting
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Mystic, Conn.

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry & Mach. Co., Trenton, N.J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STANDS—
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Roll-a-Reel, Cincinnati, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Roll-a-Reel, Cincinnati, Ohio
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Drawn Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Chicago, Ill.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio.

REELS & SPOOLS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS & SPOOLS—Plastic
Hubbard Spool Co., Chicago, Ill.

REELS & SPOOLS—Steel
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Clark, J. L., Mfg., Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine.

REELS & SPOOLS—Wooden
Acrometal Products, Inc., Minneapolis, Minn.
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
North Anson Reel Co., North Anson, Maine.

REELS—Metal Bound
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
North Anson Reel Co., North Anson, Maine.

REELS—Takeoff
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Clark, J. L. Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Drawing
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

WHERE TO BUY, Continued

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mason Can Company, Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Rockwell W. S., Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N.Y.

RODS—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.

RODS—Nickel Alloy
International Nickel Co., Inc., New York, N.Y.

RODS—Stainless Steel
American Steel & Wire Co., Cleveland, Ohio.

RODS—Wire—Non-Ferrous
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
American Steel & Wire Company, Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Roebling's John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SALTS—Heat Treating, Descaling, etc.
Holden, A. F., Company, The, New Haven, Conn. and Detroit, Mich.

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc., Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Potter, Neil Co., Newark, N. J.
Standard Industrial Compounds Co., Inc., Chicago, Ill.
Swift & Company, Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Steel
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Roebling's, John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

TANKS—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TINSEL—Cords, Decorative
(See: Tinsel—Electric Conductor)

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL—Electric Resistance
(See: Tinsel—Electric Conductor)

TINSEL—Lame, Silver and False Gold
(See: Tinsel—Electric Conductor)

TINSEL—Thread, Silver and False Gold
(See: Tinsel—Electric Conductor)

TINSEL—Thread, Decorative
(See: Tinsel—Electric Conductor)

TINSEL—Wire
(See: Tinsel—Electric Conductor)

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels
Entwistle, James L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Fenn Manufacturing Company, Hartford, Conn.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc., Pawtucket, R. I.

TUBE BENDERS AND FORMERS—
H. D. Kilmer Co., Cleveland, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—
Fenn Manufacturing Co., Hartford, Conn.

VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—For Insulation
Standard Varnish Works, Staten Island, N. Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WEAVING—Industrial Wire Cloth
(See Machinery—Weaving Wire Cloth)
Bruckner-Mitchell, Inc., New York, N. Y.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y Co., Phila., Pa.
Davis R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

WIRE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Malin & Co., Cleveland, Ohio.

WIRE—Barbed
Interlocking Fence Co., Morton, Ill.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
Malin & Co., Cleveland, Ohio.

WIRE—Flat, Fine
Montgomery Co., The, Windsor Locks, Conn.

WIRE—Manufacturers
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music
American Steel & Wire Co., Cleveland-Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio.
U. S. Steel Export Co., New York, N. Y.

WIRE—Nickel & Nickel Alloy
International Nickel Co., Inc., New York, N. Y.

WIRE—Nickel Silver and Phosphor Bronze
Malin & Co., Cleveland, Ohio.

WIRE—Spring
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Co., Cleveland-Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting
Pittsburgh Cut Wire Co., Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WRAPPING PAPER—Creped
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.

YARNS & TAPES—
Belding, Heminway, Corticelli Co., New York, N. Y.
Owens Corning Fiberglas Corp., Toledo, Ohio.
Twitchell, E. W., Philadelphia, Pa.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

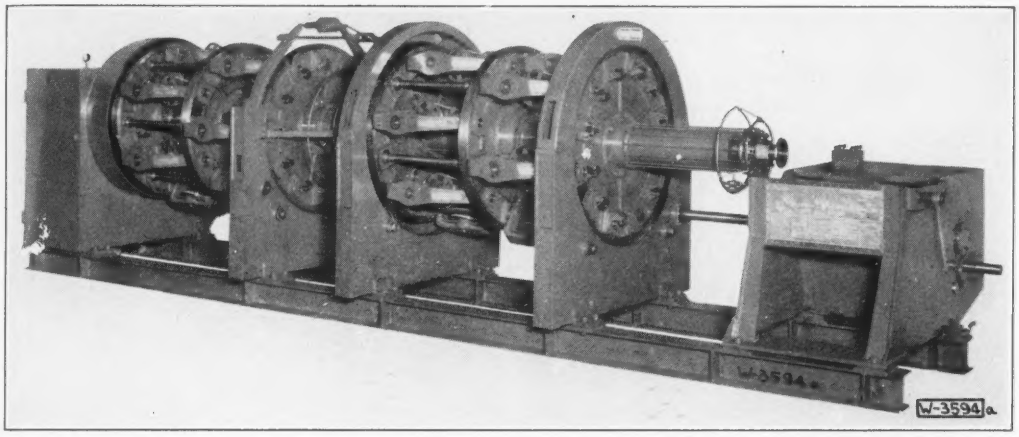
PATERSON 3, NEW JERSEY, U. S. A.

WATSON

ELECTRICAL WIRE AND CABLE AND WIRE ROPE MACHINERY

Planetary STRANDING HEADS "PH/G"- Series 1000

U. S. Patent 2,270,093

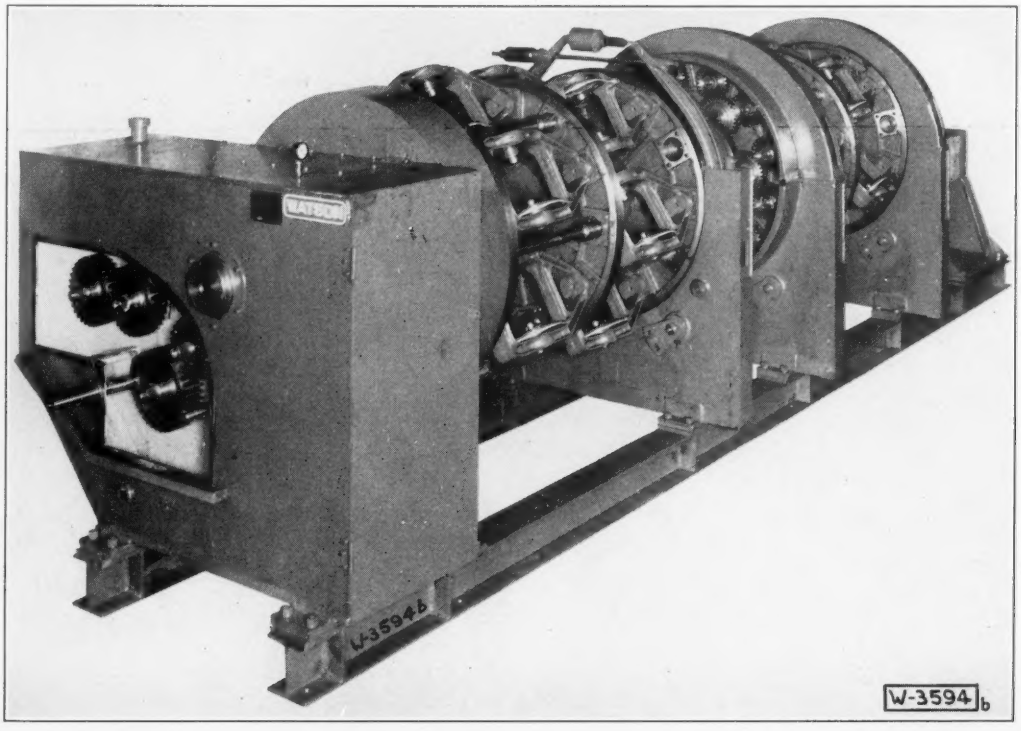


SHOWING STANDARD RIGHT HAND 24-SPOOL HEAD ASSEMBLY

Integral units mounted on single base.—With flat, retracting-pintle, anti-slap, integral-tension, fully anti-friction bearing. Geared backturn cradles, variable backturn with added change gears. Eccentric axle support rollers. Automatic spring-set, air-off brakes.

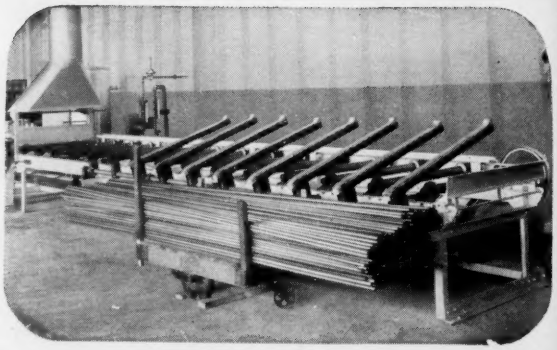
Available in many sizes and combinations.

Other, all fully up-to-date planetary head designs, lighter and heavier, provide staggered cradles, ring backturn. Filler cop spindles for cabling. Main shaft bearing support designs for heaviest duty, highest speeds, etc., etc.



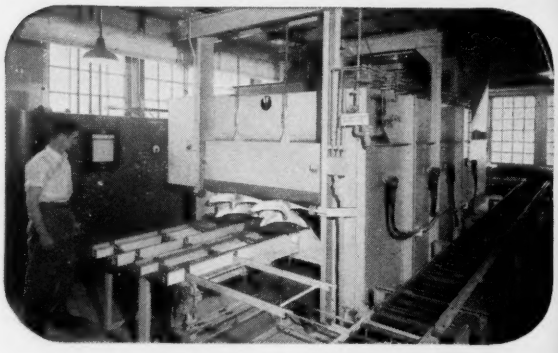
SHOWING FORCE FEED LUBRICATED HEAD DRIVE GEAR HOUSING WITH GEAR COVER PLATE REMOVED

Continuous Annealing subjects the entire length and width of the strip to same time and temperature treatment, greatly improving drawing qualities.



Bright Annealing Tubing. Discharge end of an EF continuous special atmosphere furnace bright annealing 40,000 lbs. steel tubing per day.

Clean Annealing Wire in an EF gas fired recuperative radiant tube type special atmosphere continuous roller hearth furnace. Handles coils up to 30" diameter.



Brazing and Heat Treating operations are carried out in above furnace. Other interesting installations are shown in Bulletin No. 461. Send for copy.

EF BUILDS A SIZE AND TYPE FURNACE FOR *every* HEAT TREATING REQUIREMENT

● Whether yours is a ferrous or non-ferrous annealing, brazing, forging or other heating or heat treating problem—there's an EF furnace to take care of your specific requirements. EF builds all types—in sizes for most any production—oil-fired, gas-fired or electrically heated. Consequently we can recommend *without prejudice* the design, the size and the method of firing that suits *your particular problem—best.*

For uniform, efficient, low-cost operation and results it will pay you to investigate recent EF developments—the results of over 30 years of furnace building experience. Call in an EF engineer on your next furnace problem.

Write for Bulletin 461. It illustrates 17 sizes and types—and describes each briefly.

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GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

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